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WATER GARDENING

PLANTS & GARDENS

BROOKLYN BOTANIC
GARDEN RECORD

Brooklyn Botanic Garden

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WATER GARDENING

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LETTER FROM THE BROOKLYN BOTANIC GARDEN

"A lake is the landscape's most beautiful and expressive feature. It is the earth's eye."—Henry David Thoreau

Whether you agree with Thoreau that a water feature is the "earth's eye," it is a fact that the presence of water in the garden attracts the eye and soothes the spirit. Its sight and sound provide refreshment. Its most elegant expression is the water-lily pool.

Fossil evidence suggests that the Water Lily Family is old and evolutionarily primitive. Many of these plants remain in much the same form as 160 million years ago, an indication of their survival success.

The art of water gardening has been practiced for almost 3,500 years. Archaeological evidence indicates that irrigation ditches along the Nile were planted with water lilies and other aquatic plants. Members of this family also figure prominently in religious symbolism. Ancient Egyptians buried people of means with wreaths made of petals of water lilies. Lotus were found in the funeral wreaths of Ramses II.

Different cultures embellished or simplified pools. The Persians and Muslims created pools in elegant and formal designs. The Japanese turned to asymmetric shapes and replications of nature. Interest in water gardening accelerated in the Western world, especially in England, in the mid 1800s with the discovery in the tropics of *Victoria regia* (now *V. amazonica*).

Hybridizing of water lilies began in the late 1800s when Joseph Bory Latour-Marliac embarked on a breeding program and developed seventy varieties. Many Marliac varieties still remain in the trade.

Anyone who is interested can have a water garden. If you are fortunate enough to have a pond or the space to make one, the horizon is without limit. With less space, a small pool can be constructed and even an apartment terrace can house a small water lily in a tub.

Whether your water garden is a pond, pool, or bucket—enjoy it.

Barbara B. Pesch
Editor

THE WATER GARDEN

From *The Water Garden,* 1897, by

William Tricker

Water Lilies, or Pond Lilies, have existed through the ages. The native [American] species, *Nymphaea odorata,* the white fragrant Pond Lily, was introduced into England in 1786. The English species, *Nymphaea alba,* also white, was recognized long before; these two species have become widely known and the general impression has been that all Water Lilies were white, hence the expression of surprise when one sees a red, yellow, or blue Lily for the first time.

Aquatics are associated with the ancient Egyptians in their literature. Mention is made of the Lotus or Water Lily, the name being applied both to Nelumbos [true lotus] and Nymphaeas [water lily], and, in fact, to several other plants in different parts of the Old World. Three distinct species are represented on many Egyptian monuments and are known to botanists and gardeners of the present day as *Nelumbo nucifera, Nymphaea lotus,* and *N. caerulea.* Nelumbiums were not only known to the Egyptians, but were common in the East and West Indies, China and Japan, Persia, and Asiatic Russia. The United States can also lay claim to one Lotus—*Nelumbo lutea*—the well known yellow American Lotus.

Amongst the many plants now grown for the embellishment of our gardens, public parks, and cemeteries, are hardy herbaceous plants, bulbs, annuals, tender plants known as bedding plants, subtropical plants, and last, but not least, aquatic plants. As Orchids are amongst greenhouse plants, so are aquatics amongst garden flowers, "The Elite." These are comparatively new and of recent introduction, though they have been known to collectors and a few cultivators for a number of years; but adaptability of them (including the most tender Nymphaeas and *Victoria regia*) for general culture out-of-doors in summer is a realization of recent date.

No class of plants is more widely distributed than Water Lilies, being indigenous to the United States, Canada, Central and South America, East and West Indies, Japan, China, Siberia, England, Europe, Austria, Africa, and Australia, each country possessing its own or several species of marked distinction, size and color. No class of plants possesses such diversity of color, including red, white, yellow, and blue, and intermediate shades. The members are no less distinctive in point of fragrance, as nearly all are possessed of an aromatic, delicate, and pleasing odor. They are also very unlike the host of other favorite flowers: some are day-blooming and close at night, others are night-blooming and close in the day. As a rule, the flowers open and close for three days or nights in succession, generally the first day flower closes early, and on the third day after closing it sinks beneath the water and matures seed—if so be it that it produces seed at all!

There is a great variation in the shape and size of Nymphaea flowers; some are beautifully cup-shaped, others star-shaped with long flat petals, tapering to a point, as *Nymphaea gracilis,* some species have long stiff stems, 12 to 18 inches above water, while others are flexible and the flowers float on the surface of the water. Nymphaeas have all leaves floating, but occasionally, when crowded, the leaves stand out of the water. *N. tuberosa,* one of the strongest growers, soon crowds its own foliage out of the water, and often indeed the rhizomes likewise.

The introduction of the *Victoria regia* into England gave a stimulus to aquaticulture, and many tropical Nymphaeas had reached England prior to the introduction of the Victoria, also Nelumbos; their cultivation, however, had never become general. The facts that they could not be grown out-of-doors, and that numerous tropical plants occupied the space of the greenhouse and conservatory to better advantage, were potent factors in this.

About fifty years ago the *Victoria regia* was first introduced into England, and two years later was grown in a special house erected for it by Mr. Cope, of Philadelphia; with it other tropical aquatics were introduced and this marks the commencement of the cultivation of aquatics in the United States. Little progress, however, was made; the indulgence in the new cult involved considerable labor and expense, and only the few could enjoy such a floral luxury. In 1853 Mr. John Fisk Allen, of Salem, Mass., exhibited a leaf and flower of *Victoria regia* before the Massachusetts Horticultural Society; other aquatics were also exhibited, and the cultivation of such increased somewhat, but it was not until it was found that the Egyptian Lotus, *Nelumbo nucifera,* was quite hardy that aquatic gardening commanded real attention. The introduction of that plant, as well as of several species of Nymphaea, into the public parks and gardens became general throughout the United States. At the present time [1897] exhibitions are not complete without a display of aquatic flowers, and they have ever proved to be a special feature and center of attraction wherever shown. The aquatic plants at the World's Fair [1893] in Chicago attracted considerable interest, and their cultivation has increased by rapid strides since that time. ♆

Roche

A semi-double tropical water lily in a granite-edged pool. At the lower left is water hyacinth, a rampant weed in areas where it is not killed by frost at the end of the season.

The Victoria regia

From *The Water Garden* by William Tricker, 1897

The *Victoria regia* is now well known throughout the civilized world, although its introduction into England and the United States dates back to a period less than fifty years ago. It is grown most successfully in the open air, and is a very great attraction whenever seen, it is the grandest and most wonderful of all aquatic plants. It is a native of South America, where it inhabits the tranquil bays of the great streams. The earliest traveller who discovered it was Hoenke, in 1801. Dr. Lindley tells us that "Bompland subsequently met with it, but M. D'Orbigny was the first to send home specimens to Paris in 1828; they were, however, neglected or overlooked. In a work published some few years after this time, M. D'Orbigny mentions having discovered the plant in the river Parana in Guiana. It was known, he says, to the natives by the name of Irupe, in allusion to the shape of the leaves, which resemble that of the broad dishes used in the country. The Spaniards call the plant water-maize, as they collect the seeds and eat them roasted."

It was a great day, horticulturally speaking, when on the first day of January, 1837, Sir R. Schomburgh came upon this noble plant in British Guiana. A German traveller had found it in some tributaries of the Amazon in 1832, but it was when Sir R. Schomburgh, in a letter to the Royal Geographical Society of England, described the largest specimen he had met with, that public attention was drawn to this magnificent plant. Sir R. Schomburgh rightly described it as a vegetable wonder. It was while

Left: *Royal Water-Lily* by William Sharp from *Victoria regia* by John Fisk Allen, 1854.
From the Collection of the Pennsylvania Horticultural Society Library.

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proceeding up the river Berbice that he came upon it. "It had gigantic leaves five to six feet across, with a flat broad rim, lighter green above and vivid crimson underneath, floating upon the water, and in character with such wonderful foliage I saw luxuriant flowers, each consisting of numerous petals passing in alternate tints, from pure white to rose and pink. The smooth water was covered with the blossoms, and which possess the additional charm of extensively diffusing a sweet fragrance." Its introduction to gardens is probably owing to Mr. Bridges, who, in his journey through Bolivia, found the *Victoria regia* in considerable abundance, and he brought home in 1846 seeds in wet clay, well-dried foliage, and flowers in spirits.

The first flower was produced in England in November of 1849, and was presented to Her Majesty, Queen Victoria, in whose honor the plant was named. Its gigantic leaves are five to six feet in diameter, turned up at the edges, five to seven inches additional. The upper surface is of a deep brilliant green, the under side a vivid crimson, and furnished with strong veins which are cellular, filled with air, and form a regular and elegant network. The underside of the leaf, as well as the foot stalks of the leaves and flowers, are covered with very prominent and elastic spines. The peculiar formation of the under surface of the leaf imparts to it great buoyancy, rendering the mature leaf capable of bearing a considerable weight, not infrequently 150 to 200 pounds, and a plant grown at Tower Grove Park, St. Louis, in 1896, had a leaf that bore the unprecedented weight of 250 pounds. A Victoria was grown at Clifton, N.J., which had at one time twenty perfect leaves in different stages of development, and which produced a large number of its magnificent flowers from July to October. These flowers are not less marvelous than the leaves; when expanded a bloom measures from fifteen to eighteen inches in diameter, the petals are very numerous, the color, when the bud first opens, is white, passing by successive shades, the second day, into a rosy hue, a lively red to crimson. The flowers exhale a pleasant odor, not unlike that of a rich pineapple, during the first evening on opening; this is distinctly perceptible as soon as the sepals show signs of bursting, and hours before the flower is open. The bloom lasts but two days, or more correctly speaking, two nights, during the hot weather, but occasionally at the end of the season the flowers endure three days.

Later it became a difficult matter to obtain seed of the true *V. regia,* and being desirous of securing it I determined to try a new field for supply, and during the winter, 1893-94, received from a European house some seed purporting to be of the true *Victoria regia.* Some of this was sown about the 10th of March under precisely the same conditions as other Victoria seed, and in water at a temperature of 85° to 90° Fahrenheit. After waiting a month and seeing no signs of germination, I gave up hopes of securing a plant for that season; but at the same time I examined another portion of the same lot of seed which had not been subjected to a higher temperature than that of the house, and was greatly surprised to find several had germinated. The seedlings were potted off singly, and treated as other young Victoria plants; subjected to a temperature of 85°, and re-potted at intervals until planted in permanent quarters on May 20.

From the first these seedlings exhibited a feature which marked them as entirely distinct from the original form, the leaves being light green and mottled with reddish brown on the face, purplish below. The rapid growth and the early cupping of the leaf were also very noticeable. In its permanent quarters the growth of the plant was still more remarkable, and it was soon evident it would outrun the older plants of the other variety, which in fact it did, at a very early date. The first flower was produced about July 15, and during August the same plant produced twelve magnificent flowers; these on first opening were pure white, and on the second day of a lively rose color. At one time as many as nine flowers and buds were visible in different stages of development, while var. Randii produced but half that number, and seldom had more than five presentable leaves at one time.

The same characteristics of the plant have been manifest during the past two seasons, and it has exhibited a tendency to flower at a very early stage. Last year a few plants that were not wanted were allowed to remain in eight-inch pots, where they produced flower buds and one perfect flower, and would have continued to flower had they not been removed. Last season one plant of this variety produced some pods of seed, one of which bursted earlier than was expected, and not having been bagged the seed was scattered. So far as was possible the seeds were picked up, but a number escaped notice and sank. Early in July, 1897, a number of seedling Victoria plants made their appearance on the surface of the water (which is about two feet deep).

During the winter but little water remained in the pond, and at one time what was there must have been frozen nearly solid; in spring the water was drawn off, the bottom, consisting of pure stiff clay, was pounded firm, and a layer of sand put upon it; the young plants referred to above are firmly rooted in the clay bottom and have every appearance of being strong and vigorous.

The partiality for a comparatively low temperature is a remarkable feature of this variety (which we distinguish provisionally as "Tricker's variety"). In no case has seed germinated when subjected to a temperature of 85° to 95°; it enjoys a temperature similar to that which is usually afforded tender Nymphaeas, and there can be no doubt whatever but that it will become a universal favorite, as it can be grown successfully under precisely the same conditions as the tender Nymphaeas.

Another variety of *Victoria regia* is recognized in England as Dixon's and is characterized by the deep coloring of its flowers.

Thus far we have records of at least three distinct forms beyond the type, but so far their exact standing has not been determined. Provisionally classed as varieties of Schomburgh's original plant, it may be that at least one of them is worthy of specific distinction, but that can only be determined on a fuller and longer acquaintance.

Victoria regia is of easy culture; coming from a tropical country, it requires a summer temperature all the season, to grow it successfully. In its native habitat, it is a perennial, but with us, the best method is to treat it as an annual. It forms no tuber, nor rhizome, as do Nymphaeas. It produces seed freely, and if the season be sufficiently long, or if artificial heat be supplied, the seed will ripen, but it takes from two to three months to ripen the seed. After it is ripe, it should be kept in water continuously, and in a temperature not below 60°.

The seed should be sown during February and March, according to the section of the country, or facilities for growing the plants. The water temperature for starting the seed should be 85° to 90°; the seed sown in pots, or seed pans and placed in shallow water, will develop the seedlings in about twenty days, although occasionally, some will make an appearance in ten days. These should be potted off singly into thumb pots as soon as the second leaf appears; the water temperature for potted plants need not exceed 85°; the young plants should be repotted at intervals, keeping them steadily growing until they are planted out in their summer quarters. Sufficient room must be given at all times, so that the leaves are not crowded so as to overlap each other. ❦

Courtesy of Slocum Water Gardens

ON THE CORRECT NAME FOR THE ROYAL WATER LILY

Ghillean T. Prance

Although we tend to think of the Royal water lily as *Victoria regia,* technically this is incorrect. In fact, since 1850, according to the rules of the "International Code of Botanical Nomenclature," it should have been called *Victoria amazonica.*

The reason for this is that the first botanist to collect and describe this plant was E.F. Poeppig, the German explorer who, in 1936, named it *Euryale amazonica.* This placed the species in a genus of water lilies, *Euryale,* known previously only in China and Southeast Asia.

At about the same time Richard Schomburgk, in his pioneering exploration of British Guiana, collected this same species. The material from the Schomburgk expedition was studied and described by British botanist John Lindley who thought it to be both a new genus and species. Thus in 1837 Lindley described this plant as *Victoria regia* and named this most majestic of all water lilies for Queen Victoria.

A few years later in 1850 James DeCarle Sowerby, a British botanist, realized that the names *Euryale amazonica* Poeppig and *Victoria regia* Schomburgk referred to the same species. He also thought that the two genera *Euryale* and *Victoria* were different. Accordingly, he proposed that the genus *Euryale* be used only for the single Asiatic species and that the South American species be kept in the genus *Victoria.* However, according to the code of nomenclature the oldest specific epithet or species name must be applied to any species. Since the epithet *"amazonica"* was given to the species in 1836, just one year before the name *"regia"* was used by Lindley, Sowerby made what is called a new nomenclatural combination. He combined the genus named *Victoria* with the older specific name *amazonica.* Hence the correct name for the species is *Victoria amazonica* (Poeppig) J. DeC. Sowerby. This is not a recent nomenclatural correction since it dates back to 1850, but people in general have been reluctant to give up the elegant name *Victoria regia.* With the correct name of *V. amazonica* at least the Queen is still honored by the generic name and the species is more appropriately named for the region to which it is native.

You will be glad to know that there are no such nomenclatural complications for the other species of the genus *Victoria, V. cruziana,* the Santa Cruz water lily, a native of Argentina.

Photos courtesy Slocum Water Gardens

TROPICAL WATER LILIES IN THE HOME WATER GARDEN

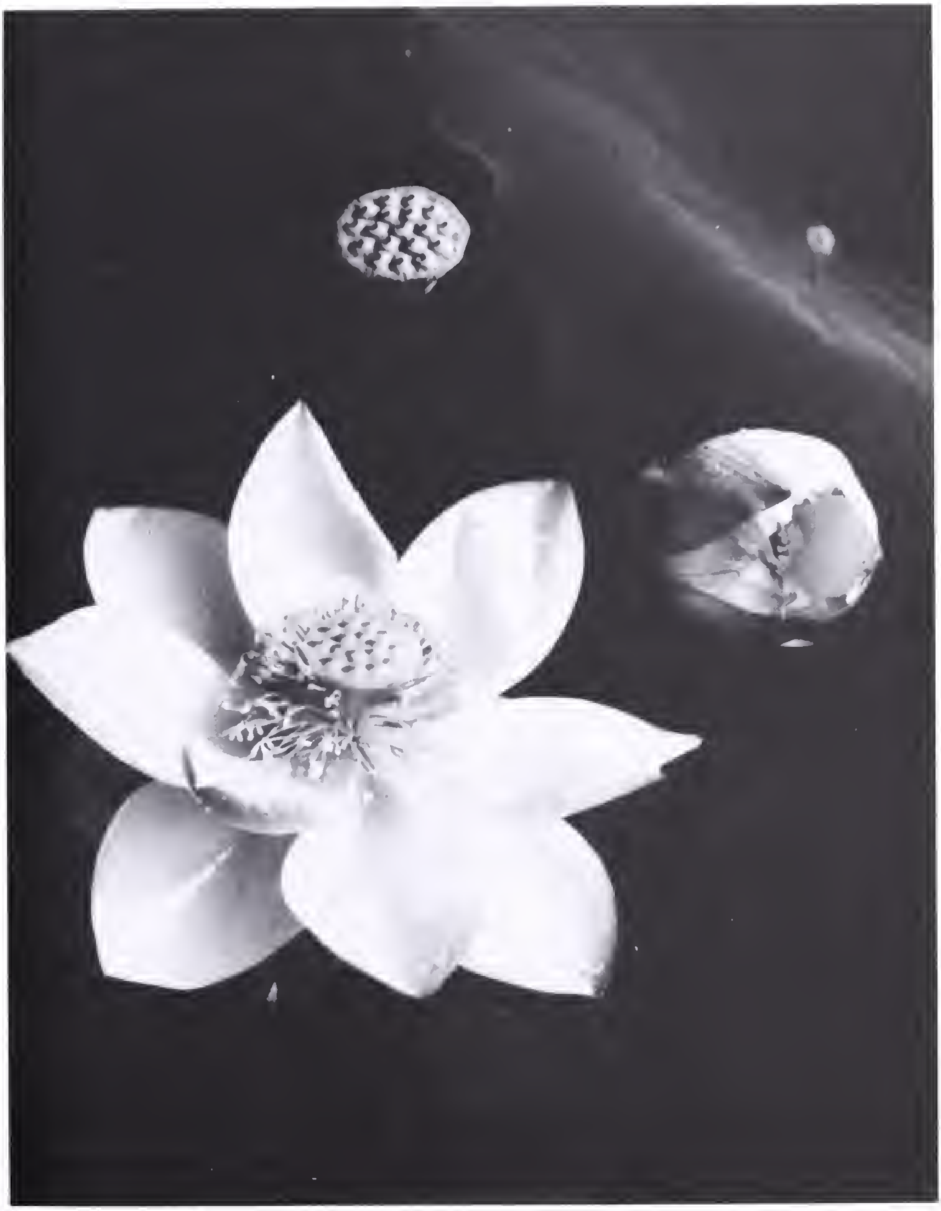
Marilyn LeDoux

The tropical water lily is one of the most beautiful plants that can be grown in the home water garden. It is very floriferous, blooming from early summer until frost, and it comes in a wide range of vibrant colors including red, pink, blue, purple, yellow, green, white, and autumn shades. The large and quite fragrant flowers are held 6 to 18 inches above the water and are striking both from a distance and up

Victoria amazonica (*V. regia*) the first night of bloom. Victorias are night-blooming water lilies that bloom white the first night and deep pink the second.

close. The tropical water lily also has beautiful foliage which can be either lush green or mottled.

Tropical water lilies are relatively easy to grow, their main requirements being full sun, rich soil, and warm, quiet water.



Asiatic lotus (*Nelumbo nucifera*) flower with bud and spent flower, the latter now turning into a lotus pod.

'Enchantment', a freely-blooming large day-blooming water lily in a rich medium pink.

Light

Full or nearly full sun is very important because the more sun the water lily receives, the more blooms it will produce. Water lilies should not be grown at all unless at least 5 to 6 hours of full sun can be provided each day. Sunlight is also very important for warming the water.

Soil and Containers

At least one-half bushel (16 quarts) of soil should be used for each tropical water-lily plant. Heavy garden soil is ideal. Mix three parts of soil with one part of well-rotted cow manure. If rotted cow manure is not available, use one cup of 12-12-12 lawn food mixed into one-half bushel of soil. Fertilizer specially blended for water lilies is also available from commercial water-lily growers. Use at recommended rate.

Planting

Once the soil has been prepared, the water lily should be planted so that its crown is just above the soil line. Then cover the soil with sand or pea gravel to crown level and slowly submerge the container into the water. The sand or gravel helps prevent the soil from clouding the water. Water lilies may also be planted in containers that are already submerged. Just press the roots into the soil until the crown is at soil level. It is important never to cover the crown with soil. Depth from water surface to crown of plant should be approximately 4 to 12 inches.

When To Plant

Tropical water lilies should be planted only when the water temperature reaches 70° F or above. Planting before this time can result in dormancy and a long delay before growth resumes. In St. Louis, water temperature will usually reach 70° in late May. Localities farther north of St. Louis will be correspondingly later and localities south, earlier.

Summer Care

Feeding water lilies two to three times during the summer will result in more and larger blooms. Commercial fertilizer tablets pressed into the soil around the water lily are easiest to use. Granular fertilizer such as 12-12-12 lawn food may also be used. Place a handful in a small paper bag or newspaper and press into the soil around the roots on two sides of the plant.

Optional summer care includes removing any old, yellowing leaves or spent blooms.

Pests

Tropical water lilies are relatively pest-free. Occasionally they will get aphids, caterpillars, or worms. Aphids can often be controlled by hosing them off the leaves. For more severe infestations, aphids can be controlled with any insecticide that lists controlling aphids on its label. Use care if fish are in the pool. Caterpillars and worms are best controlled with the biological insecticides Dipel or Thuricide. These are harmless to fish.

Winter Care

For most people, tropical water lilies are best treated as annuals and purchased new each year. However, the containers of water lilies can be kept in a greenhouse pool over winter. The plants will probably go dormant, because of the cooler water, but should resume growth when the water warms up again in the spring.

Varieties

These are two types of tropical water lilies—day bloomers and night bloomers. Day bloomers open in the morning and close in late afternoon or evening. Night bloomers open in the evening and remain open until midmorning on sunny days, longer on cloudy ones. Day bloomers come in blue, purple, pink, yellow, red, green, white, and autumn shades. My favorite varieties include 'Bagdad' (blue), 'Persian Lilac' (pink), 'Evelyn Randig' (magenta-rose), 'Green Smoke' (green), and 'Albert Greenberg' (yellow-and-pink bi-color). Night bloomers are only available in red, pink, and white. My favorites are 'Red Flare' (red), 'Mrs. George C. Hitchcock' (pink), and 'Missouri' (white).

'Eldorado', a deep yellow flower with mottled leaves, is another day-bloomer. This means it opens in the morning and closes in the late afternoon.

Sources

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A SMALL GARDEN POOL FOR HARDY WATER LILIES

Judith E. Hillstrom

Create a new dimension in your garden landscape with a simple tub pool and a hardy water lily. Within this Lilliputian world your imagination can come alive. Add goldfish for splashes of color, watch frogs who may come to visit, fall under the charm of a floating water-lily blossom. What a delight on a midsummer's day!

There is a magic and fascination in water gardening, and with planning and some dedicated work your fantasy can become reality. To begin, use the hardy water-lilies' cultural requirements as a guide in choosing the site for a garden pool. Selecting the correct spot is the most important consideration, since proper exposure is critical. An ideal location in which to grow water lilies is one which receives sun all day. A minimum of four hours sunlight produces lush foliage but few blossoms. Where shade is a problem, more bloom can be encouraged with judicious pruning of overhead foliage. Water-lily bud development will be regulated in direct proportion to the amount of sun it receives.

A Simple Tub Pool

When we think of a garden pool, pictures come to mind of those gracing the lawns of stately mansions. However, such limitations as space and modest budgets necessitate a more practical approach. A prudent alternative, in terms of cost, is the tub pool which can be placed singly or in a group. With the proper framework and attractive plantings, a common washtub can be transformed into a miniature water garden.

Galvanized washtubs were manufactured in three shapes: round, square, and oblong—measuring 23 inches in diameter, 22 inches square, and 42 inches long, respectively. The depth of all sizes is 12 inches. Although metal washtubs are not readily available in stores nowadays, they may be found in Grandmother's cellar or perhaps at a garage sale. A bit of hunting may bring success and can add to the adventure.

With tub in hand and the location selected, work can begin. Turn the tub upside-down on the site after clearing away all grass, plants, and debris. Using a pointed instrument, sketch an outline of the inverted container in the soil. Lift off the washtub and dig the hole within the outline. Make the opening slightly larger than the marking on the ground. These few inches are needed to jockey the tub into position. Permanent placing should be approximately one inch above ground level to avoid soil washing into the pool after watering and rainstorms.

Lower the tub into the open hole. Rest a board across the rim for a carpenter's level. When tub is level, put dry sand into crevices and gaps between the earth wall and side of tub. This will hold the tub in place. Sand is used, particularly in the north, as a safeguard against the heaving caused by winter thaws. Tamp the sand firmly around the tub using a broad, wedge-shaped stick. After the narrow space is filled, scoop out a small trough around the tub's rim. This small moat prevents unwanted elements from slipping into the pool.

This washtub is your future pool and when it has settled in, you may disguise the galvanized rim. Brick and mortar is formal; while at the other extreme, natural or tinted gravel might be spread as a

Perry D. Slocum

For a smaller pool, these dwarf water lilies are perfect. Clockwise from upper right: 'Marliac White', pure white, free-flowering; 'Pink Opal', deep salmon pink with rich fragrance; 'Golden Cup' ('Chromatella'), clear yellow with mottled leaves and a long blooming season.

ground cover intermingled with trailing plants. I used flat limestone. The irregular pieces of rock were chosen in sizes that could be handled easily. Stones were placed in the earth around the perimeter of the galvanized tub. Set the stones so that they extend toward the center a few inches beyond the rim edge. Patience is required to fit the stones together so the tub edge is concealed and the arrangement attractive.

A word about the life expectancy of galvanized washtubs: metal tubs withstand the rigors of natural elements quite well, but after ten years or so, check for leaks each spring prior to planting. Fill the tub with water and let stand several hours. Watch for a point where the water stops receding. Side seams may widen and begin to leak. These leaks can be plugged with caulking. When the fissure is in the tub's bottom, a coating of tar will solve the problem.

With stones in position, their tones blend into the surrounding earth. Now the washtub no longer exists. In its place there is a garden pool awaiting plants.

Hardy Water Lilies

Leaves of hardy water lilies are smooth and round, measuring four inches in diameter, in some varieties mottled with chocolate. Their flowers bloom in glistening white and in shades and hues of red, pink, and yellow.

There is a pygmy variety of hardy water lily (*Nymphaea* x *helvola*). It has two-inch pads and bears blossoms a mere inch across. It is a good candidate for tub pools—two to three water lilies to a pool.

In choosing your first hardy water lily, the 'Marliac White' is the easiest to grow and longest lived; mine has survived over two decades. The red 'Gloriosa' lives not as long, yet with proper winter care its usual life span is six seasons.

Culture: Plant hardy water lilies when daytime temperatures reach 60° F. Hardy types are not affected by chilly night temperatures, but guard against hard frosts as mildew will form on the crown and retard growth.

When planting water lilies, it is wisest to build a planting-box unit from old lumber, rather than to put soil and lily root directly into the bottom of the pool. When winter approaches you can lift the entire unit out and carry it to storage. A box 12 inches square by approximately 7 inches deep is workable. Never use redwood as it is harmful to fish. Pygmy varieties grow well in 6-inch clay pots.

Hardy water lilies are shipped bare root from mail order nurseries specializing in water plants. Upon arrival, unwrap the rhizome; it will be black in color, elongated, and solid. At one end is the crown from which leaves and buds sprout, while fat, yellow, fleshy roots grow along each side of the tuberous rhizome. With age the rhizome enlarges, and the toughness of this hardy and succulent rhizome enables it

Courtesy of Lilypons Water Gardens

'Hollandia', a hardy water lily, is clear pink shading to shell at the edges, bears huge flowers in profusion and is an excellent cut flower.

to withstand abrupt weather changes during summers outdoors and to survive long winters.

Before planting the water-lily root, form a long mound of soil down the center of the box. This low ridge of soil will hold the rhizome with the crown in a slightly raised position. Then press the roots firmly into the planting mix. Do not cover the crown. When finished the back of the rhizome should be barely visible beneath a thin layer of soil.

After the rhizome and roots are securely anchored in the planting box, cover with a half inch of coarse brown sand or gravel to prevent muddying the water.

Use soil of heavy consistency such as fertile garden loam with clay. Do not use peat, sandy-textured material or soil from woods or swamp.

Water lilies are heavy feeders. Aquatic specialists offer a fertilizer specifically formulated for *Nymphaea* culture. Follow directions on the package of this commercial plant food—in concentrated, nonburning form it is meant to be mixed into the soil at planting time.

Pulverized, commercially bagged cow manure is used by some growers. The proportion is one part dry manure to three parts soil. Do not use fresh manure. It mucks the soil and turns water to a brown tea.

Filling the Pool

Place the planted box in the bottom of the pool. When filling the pool after the box is in place, anchor the end of the hose at pool bottom, positioned so the trickle of water is aimed toward the metal wall. Should the box shift while water is flowing, wedge a rock firmly between box and pool wall. Although you may have filled the pool brimful a few hours ago an inch or so of vacant space shows below the rim. This water was soaked up by the soil in porous planting containers. Add water as needed to compensate for evaporation. Refills are accomplished without bother at the same time you water your flower border with the garden hose. Water in the pool need not be changed unless it becomes dirty.

A water lily correctly planted in properly fertilized soil will begin to grow immediately. By midsummer, foliage will be lush. When lily pads tilt upright in the water, remove older leaves to permit sunlight to filter through the water. This will encourage greater bud production.

Winter Care

Winter storage of the hardy water lily is simple when you have a place where temperatures remain in the 40° to 55°F range such as a cool basement corner or root cellar. In autumn, prior to a hard freeze, lift the planting box from the pool and allow to drain for a few hours. Do not cut off leaves. Pack moist compost over the damp soil to keep it from drying out through winter months.

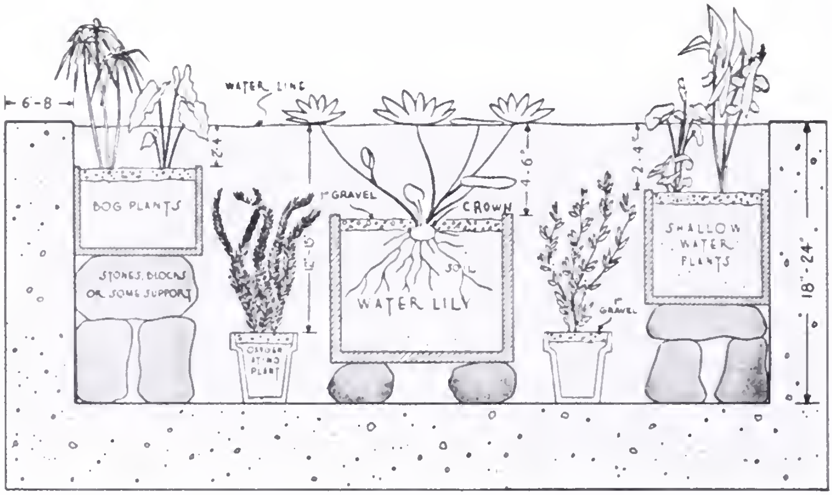
The following spring carry the lily box from its storage place out into the garden. Invert the box, shake and pry away last year's soil from the rhizome. After the rhizome is carefully cleaned, examine it for suckers. Suckers are tiny, yellowish leaves sprouting near the crown or in the tangle of roots along the side. If these are not removed the water lily will not bloom. Use a small sharp knife to cut out the sprouts. Occasionally a sucker develops into an immature plant. Free from the parent by cutting out a half-inch wedge of rhizome with a few roots attached. Plant one to a six-inch clay pot, and plantlets will grow quickly to blooming-size. Replant the large rhizome in the planting box unit with fresh soil and fertilizer.

Goldfish and water lilies make a pleasant combination and provide a fine balance of nature. Plants release oxygen and absorb carbon dioxide, while fish work in the reverse. Each assists the other in keeping the water clean. Fish eat their fill by nibbling algae off pool walls and also consume insect larvae.

When envisioning blossoms of the water lily none wrote more eloquently than Mrs. N.E. Lovejoy in the *Journal of the Columbus Horticultural Society* of 1887: "You may look upon a mountain and wish it were loftier or more precipitous; upon a river and wish it were clearer; upon a tree and desire for it some greater spread of its boughs, some richer shadings of its foliage. But you cannot look upon a water lily and wish it to be other than it is." ❦

How To Plant Your Lily Pool

Courtesy of William Tricker Inc.



Courtesy of William Tricker, Inc.

Pools with sloping sides may be arranged in this same manner. All supports should be solid and secure to avoid tipping over.

How To Plant

Water lilies are very easy to grow. Under natural conditions the roots are in rich soil in the shallow water of a marsh or pond exposed to full sunshine. These conditions are easily reproduced in the garden. In natural ponds, hardy water lilies may be planted in water from 6 to 18 inches deep and are planted simply by pressing the root into the good soil at the bottom. Small artificial pools should be at least 1 foot deep, allowing for 6 inches of water over 6 inches of soil. In larger pools use containers, either tubs or boxes, holding at least one bushel of soil. The depth of the water may be from 6 to 12 inches over the tub or container. Artificial pools need not be more than 24 inches deep. Twenty inches makes a satisfactory depth. It is best to provide a separate container for each water lily or lotus.

Do Not Drain Pool Before Planting

Prepare all the necessary containers, place them at the proper levels (see diagram) and fill the pool with water. It is preferable to plant your lilies and other aquatic plants in their containers before immersing in pool. It is important, however, that the crown on the water lily (the growing end) should not be below the surface of the gravel.

Soil

The best soil for water lilies and aquatic plants is a mixture of three parts of good top soil and one part of thoroughly rotted cow manure—a heavy clay soil is very satisfactory. Muck from swamps, soil from woods, peat moss and sand should not be used in the soil. All soil in pools should be covered with approximately 1 inch of clean gravel which prevents any particles from the soil floating into the water and discoloring it.

Planting

Hardy water lilies may be planted quite early in the spring but not until the water has warmed up so they will start immediately into new growth. In the latitude of Chicago, Cleveland, and New York, this date is usually toward the latter part of April. For tropical water lilies the first week in June, if weather permits, is usually the proper time in the same localities mentioned above. For points south of this line the date is, of course, earlier. Tropical water lilies especially should be planted in full sunshine and in a depth of water from 4 to 6 inches. Hardy water lilies do best in a depth of water from 4 to 6 inches and lotus in the same depth as the tropical lilies.

Lotus

Lotus tubers need rich soil and plenty of room. Place the tuber in a horizontal position 2 inches below the surface of the soil and provide a depth of water 4 to 6 inches when first planted. After becoming well established the depth of water can be increased to a maximum of 12 inches, but an average depth of 8 inches of water is ideal. Handle tubers carefully in unpacking and planting so that the growing end is not broken. Potted plants are usually obtainable late in the season and are simply tubers started into growth in pots in tanks in greenhouses and when received are planted exactly the same as tropical lilies by pressing the ball of earth into the soft mud to a position just below the surface of the gravel. ❦

How To Make a Tub Garden

Courtesy of Slocum Water Gardens

Roche

1. Choose a sunny location.
2. Sink the tub at least half-way into the soil.
3. Place four inches of good garden soil in the bottom.
4. Plant hardy water lilies horizontally.
5. Plant tropical water lilies upright.
6. Plant bog plants upright.
7. Add a half-inch of sand.
8. Spread burlap bag on top of sand. (This prevents the soil being stirred up when water is added.)
9. Fill tub with water and remove sand.

Gottscho-Schleisner

Carp in garden pool

GARDEN POOLS

Edmond O. Moulin

If a water feature is in your garden plan, begin by surveying your property. Ask yourself the following questions:

1) Where does your family relax?
2) Is this area in view from inside the house?
3) Is it protected from the street and neighbors—in other words, private?

4) How is the drainage?

When these questions have been answered and you have a general idea of where you want to locate your water feature, consider also that flowering aquatic plants perform best in full sun, so the pool should be located away from large trees. This will also lighten clean-up chores because fallen leaves can clog drains and be unsightly. It is also advantageous to follow the natural contour lines of your property and to locate the pool in the lowest area if that location meets the above criteria.

The size, shape, and location of a pool or smaller water feature is a personal matter. It can be as small as a birdbath, with a simple fountain falling into a basin with the water circulated by a small pump. Wall fountains take up even less space and still provide the sight and sound of water. English ivy planted and trained to grow on the wall around the fountain provides contrast and adds textural interest. (The wall-mounted fountain is attached to a hidden pump and reservoir by tubing. The water is then recirculated.)

With such a small water feature there is the added dividend of winter use. As long as the water is moving the pump can be kept operating in freezing weather. Ice will create new sculptural effects. Antifreeze can be added if there is no danger to surrounding plants or fish or household pets. If the water isn't moving, pull the plug on the pump.

Larger pools can be constructed in any size and shape. There are prefabricated pools or pools can be created from a hole covered with heavy black plastic (see p. 24) or with poured concrete. The last requires the most time, effort, and money, but is also the most long lasting. It should be kept in mind that there is maintenance involved *after* a pool of any sort is constructed, so don't be overly ambitious at the outset.

Keep in mind also that a pool is a responsibility. If there are small children in the family or the neighborhood, the pool must be fenced with a secure gate at the entrance. Many communities have ordinances regarding the height and type of fence so that it would be prudent to check before starting to build your pool.

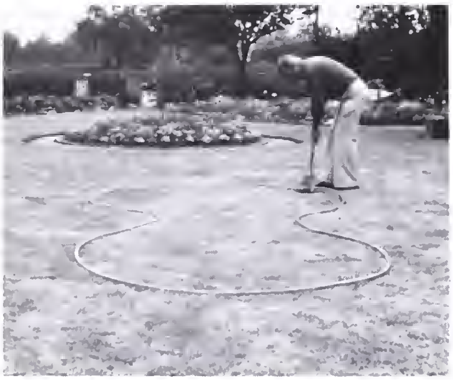
Water features can be even more complex and ambitious. A pool fed by a stream can add interest and lend itself to bridges and waterfalls. Rocks set in concrete along the edges of larger water features provide the opportunity for interesting plantings. An assortment of groundcovers such as rockspray cotoneaster (*C. horizontalis*), pumili mugo pine (*Pinus mugo* 'Pumilio'), and lily-turf (*Liriope* spp.) can be used. Creeping sedums, creeping baby's breath (*Gypsophila repens*), and annually planted alyssum (*Lobularia maritima*) also work well and provide contrasts in foliage, textures, and colors.

The addition of any water feature is a matter of personal choice. It can be large or just a small tub sunk into the ground planted with a small water lily (see p. 19). Whatever the size, the presence of water will add interest, variety and a soothing quality to your landscape. ❦

DESIGN AND PREPARATION

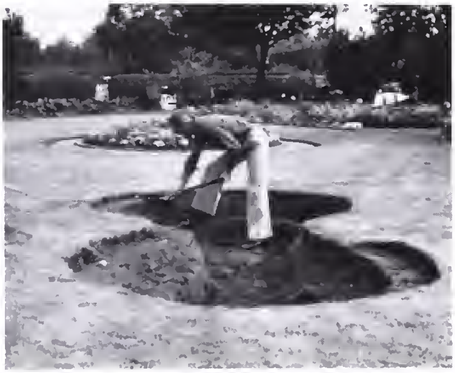
1. Draw garden to scale on paper (an overlay will allow experimentation without destroying the plan)
2. Select sunny spot for pool away from trees that might eventually shade it
3. With plan complete outline pool on site by:
    a. using a hose to outline free-form designs
    b. 2″ x 4″ lumber to outline geometric forms
    c. a string line from a center point to outline circular forms
4. Check grade of site with a level
5. Clear away vegetation
6. Dig hole within outline to proper depth
7. Be certain that pool edge is at least one inch above ground level
8. Install edging: stones, gravel, and/or plantings
9. Plant pool
10. Add fish if desired

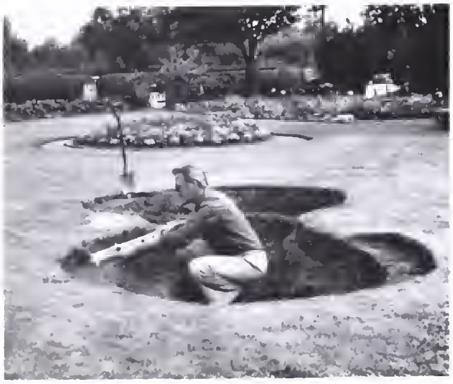
Installation of a Pool Liner



Lay a hose or rope to the required shape and size of the pool. Commence digging, but always cut inside the finished outline to allow for final trimming and shaping.

The excavation is started leaving marginal shelves 9″ below water level and 9–12″ wide (or wider) where required for shallow-water plants. In addition, the pool edge should be cut back sufficiently to accommodate the edging.





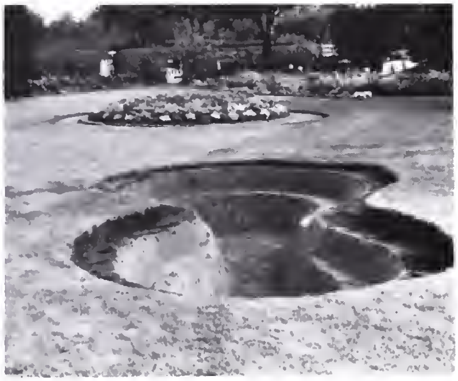
Short wooden pegs are inserted 3–4′ apart around the pool and the tops of the pegs leveled using a spirit level. The top edge of the pool must be level because the water will show immediately any faults.

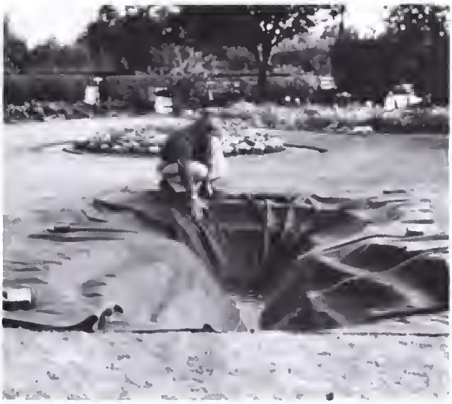
After final trimming and shaping has been completed, the depth and width of marginal shelves should be checked. The sides and base of the excavation must be closely inspected for any sharp stones or roots.

A cushion of sand 1/2″ deep should be placed on the bottom of the excavation. Sand should then be worked into the sides of the excavation to fill any holes and crevices which may have been made digging out stones.

The finished excavation should be neat and trim because any irregularities will show after the liner is fitted. On particularly stony ground, building grade polyethylene should be underlaid as an added precaution.

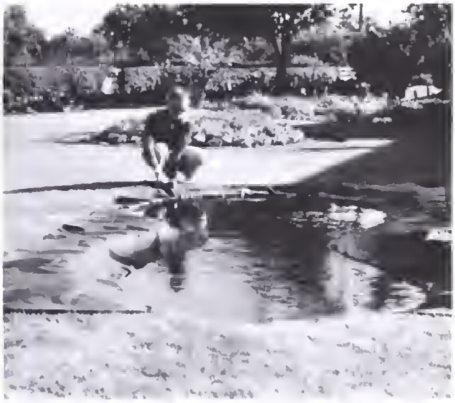
Note in the photo the lighter color of the sand.

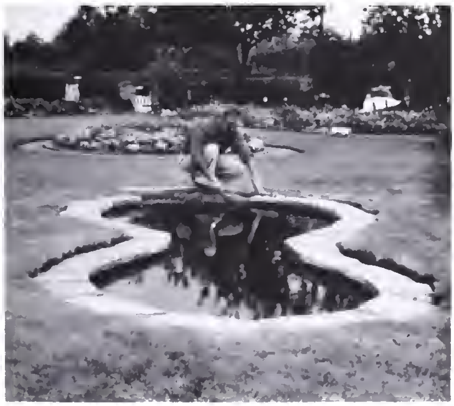




The pool liner should be draped loosely into the excavation with an even overlap all around. Stones or blocks should be placed on the corners and along the sides.

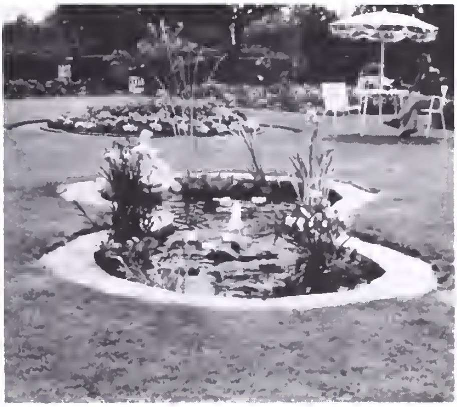
Begin filling with water. As the pool fills, the stones should be eased off at intervals to allow the liner to fit snugly into the excavation. Some creasing is inevitable, but some of these creases can be removed by stretching and fitting as the pool fills. When full, the surplus lining can be cut off leaving a 4–5″ flap. This flap can be temporarily secured by pushing 4″ nails through the lining and into the ground.





Rectangular pools can be edged with pre-cast paving. Informal pools can be edged with broken slabs or natural stone paving. Edging should be laid on a bed of mortar mixed three parts sand to one part cement.

Ideally pools should be emptied before planting and stocking with fish, and this is imperative if concrete has been dropped into the water during the construction work. Fountains, lighting and other adornments can be added during or after construction.



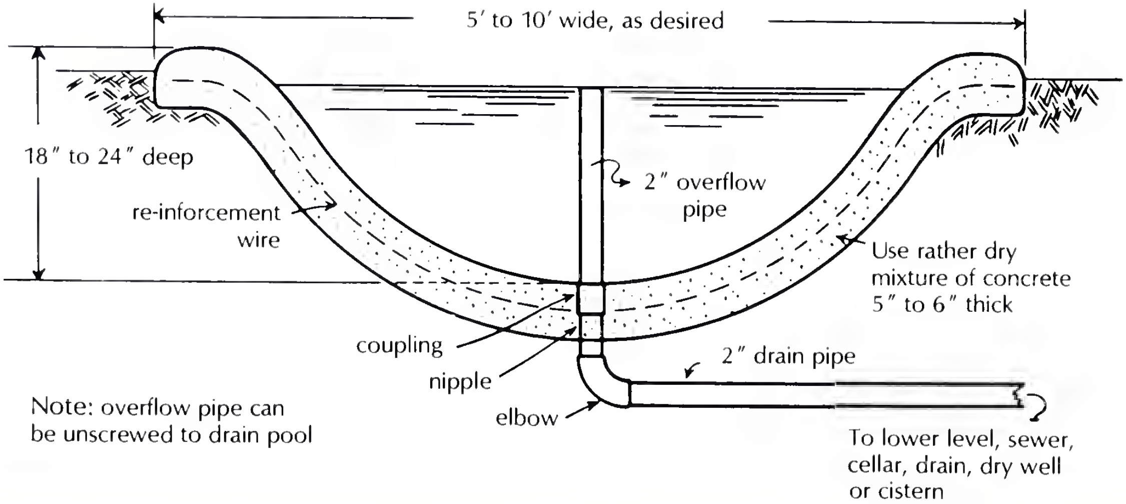
Courtesy of Stapeley Water Gardens, Stapeley, England, and Lilypons Water Gardens, Lilypons, MD

How to Build a Lily Pool

SIMPLE POOL CONSTRUCTION—CROSS-SECTION OF CONCRETE POOL

DIRECTIONS

1. Choose sunny location.
2. Dig hole with sloping sides.
3. Put pipes in place.
4. Spread 3″ outer layer concrete.
5. Lay down wire.
6. Spread 3″ inner layer concrete.
7. With broom, brush wet mixture of sand and cement over pool to fill crevices. (Use 2 parts sand to 1 cement.)


5′ to 10′ wide, as desired
18″ to 24″ deep
re-inforcement wire
2″ overflow pipe
Use rather dry mixture of concrete 5″ to 6″ thick
coupling
nipple
elbow
2″ drain pipe
To lower level, sewer, cellar, drain, dry well or cistern

Note: overflow pipe can be unscrewed to drain pool

Courtesy of Slocum Water Gardens

PROPAGATING WATER LILIES AND AQUATICS

Peter D. Slocum

Aquatic plants reproduce themselves rapidly and prolifically. This is often true in locations where we may not want such abundance—for example, the infamous water hyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata*), which are scourges of public waterways in the southern states. The opposite can seem to be true in regard to the lovely varieties that we enjoy in our garden pools, but propagation of aquatic plants is not a difficult task limited to commercial growers.

Water lilies (*Nymphaea* spp.) are divided into two major types, tropical and hardy, treated here as separate subjects because their physical characteristics are different.

Tropical Water Lilies

Tropical water lilies are the largest, showiest plants for the garden pool with flower colors ranging through the spectrum. In the Deep South in protected locations many varieties continue to grow and bloom all year. Elsewhere they can be planted when water temperatures reach 70° F and above. For most of the country this is generally sometime between the middle of May and the middle of June. Once established, they continue to grow in size and to flower until water temperatures fall below 60° in the autumn when the decline in temperature induces dormancy.

Dormancy is triggered by the cooling down of the water. Instead of the water lily utilizing its strength to produce new leaves and flowers, all energies are diverted toward the formation of a tuber to store starches and carbohydrates. As the process advances all apparent evidence of life subsides. Blooming stops and leaf size diminishes. When the cycle is complete, the plant will appear to have died.

Dig carefully into the soil at the center of the container for the tuber. This tuber serves as a storage capsule for wintering the resting plant. As long as it remains safely submerged and not frozen, the plant will remain viable. Tubers can be stored indoors in the more extreme climates. Cover the tuber with damp sand, sawdust, or vermiculite. Moisten the material and store in a cool place. Whether left in the planting container or removed, the resting plant will not require light. Use tubers the size of English walnuts for propagating in the spring.

When water temperatures rise in the spring, remove the tubers from storage and pot them in good topsoil (no fertilizer at this time) in shallow water. New leaf growth will soon appear. When surface leaves are two to three inches across, you should be able to remove the new plantlet from the tuber. Leave the tuber in place in the soil. Do not force the removal of the plantlets; wait a few more days, until separation can be easily made. More than one plantlet may be produced. Pot each individually in small pots (4–6″) using topsoil enriched with a well-balanced (10–10–10) fertilizer (one teaspoon mixed in the bottom half of the pot). In a few weeks the young plants will be ready to transplant to a bushel-size box or tub (32 qts.) or directly planted into earth-bottom ponds for the season.

Some excellent varieties which easily propagate from tubers are:

'Albert Greenberg'. Orange flowers with heavily mottled leaf patterns; blooms prolifically. One of the best.

'Director George T. Moore'. This one is a vigorous grower with darker blue flowers; it generally winters well and produces several blooms at a time.

'Enchantment'. Best of the large pink flowered lilies. Opens earlier in the day than most other day-blooming tropicals.

'Evelyn Randig'. Flower color close to 'Red Beauty' with beautiful leaves.

'King of Blues'. Large flowers of dark blue. Easy to grow.

'Mrs. George C. Hitchcock'. Largest of the night-bloomers with huge pink blossoms and tough, somewhat bronzed, leaves.

'Pamela'. Full-size lily with flowers of light blue and mottled leaves.

'Red Beauty'. Closest shade we have to a red in day-blooming tropical water lilies. Propagates easily.

'Red Flare'. Most popular red night-blooming lily. Flowers and leaves are deep wine red. Most compact grower of the night-blooming water lilies.

'St. Louis'. All of the good features of 'Yellow Dazzler' with pastel yellow flowers.

'Ted Uber'. Beautiful white flowers; tough plant. Definitely the best day-blooming white.

'Trudy Slocum'. Best of the white night-bloomers. Excellent in every way with large pure white flowers.

'Yellow Dazzler'. Deepest yellow flower, a strong growing plant. Best of the deep yellows with all of the good points we look for in choosing a water lily.

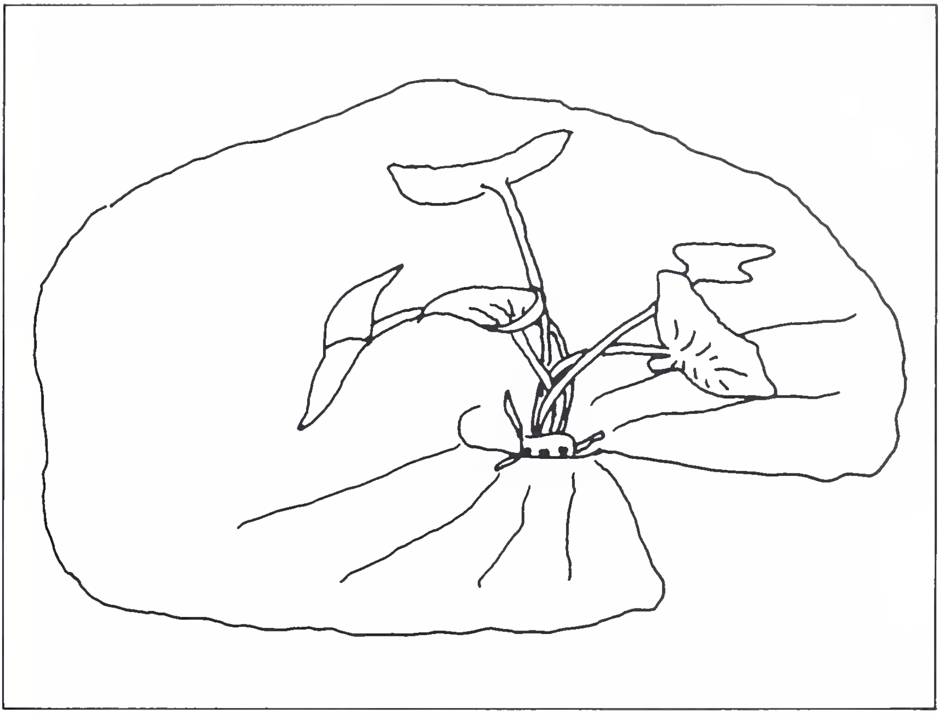
The last two lilies on this list are night-blooming, which means that they begin blooming at dusk, continue through the night and do not stop at dawn. The blossoms last until late in the morning. It is not unusual for them to continue until nearly noon each day. Night-bloomers can be propagated from tubers. Night-bloomers also reproduce during the season by vegetative means. Young plants are formed around the base of the parent plant, giving the impression of a mass of small leaves. These plantlets can be transplanted as desired without waiting for dormancy.

Some special water lilies, all day-blooming tropicals, can be propagated through the formation of perfect miniatures of the parent plant at the leaf petiole. These are known as viviparous species. They are among the most interesting to propagate. This phenomenon occurs in fairly small varieties of blue and purple hues. 'Dauben', 'Panama Pacific', 'August Koch', and 'Mrs. Martin E. Randig' are the choices most commonly available. All are good. As the young plant begins to form you should notice a furry-appearing protrusion swelling at the point where the leaf is attached to the stem. This will enlarge into a small leaf formation as the parent plant leaf begins the process of decomposition. In ideal conditions the baby plant may form and bloom while still attached to the parent leaf. In ponds with soil bottoms, the plantlets will settle to the bottom and root. Or the leaves may be placed on soil-filled pots just under the water surface so that the roots may enter the soil as growth progresses. The plant may be transplanted after a few weeks. Leaves may also be removed from parent stock before the plantlets are fully formed and floated in water where they will continue to develop before planting.

Tropicals from Seed

Some water-lily varieties will form seed pods. The base of the flower will enlarge following the completion of bloom, if seed is set. Collect seedpods and allow them to ripen in a jar or pail of water until the pod breaks. After breaking, the fleshy parts of the seedpod will rapidly decompose and in a few days the seeds can be cleaned and dried. Pour the contents of the container through a fine mesh screen. (Water-lily seeds are very tiny so the gauge of the screen must be fine enough to prevent the seed from passing through. Fine window screen can be used.) Sow seeds in soil and place in shallow water. The tender seedlings will appear soon after sowing and then can be transplanted. Seed can be sown directly into soil-bottom ponds or the seedpods may be left on the plants and allowed to self-sow. Stored dried seed will remain viable for a couple of seasons.

Victoria amazonica, the giant water lily of the Amazon River, is an example of a water lily that reproduces solely by seed. An annual that does not form tubers or produce any vegetative plantlets, its leaves are over six feet across. It blooms at night with flowers of 12 to 15 inches or more and covers surfaces exceeding 30 feet. The seeds are hard-shelled orbs about the size



Drawn from photo from Van Ness Water Garde

In the viviparous-leaved water lilies, mature plants can sprout plantlets at the point where the leaf petiole joins the leaf, or lamina. Using a very sharp knife, detach the plantlets from the leaf, then separate the plantlets. Plant in firmly pressed rich soil in either a shallow pan or dish or 4″ clay pot. Then place container in shallow water. Plants from viviparous leaves often are better able to withstand moderately cold weather better than tropicals propagated from seeds or tubers.

of the common garden pea and generally take two years to sprout. Collect the seeds in the same manner previously described, except store them in water. Second-year seed should be sown in large containers of soil or, preferably, directly into the water of the pond where they will germinate and grow to a transplanting size. Victorias are among the most tropical of water lilies and require temperatures above 70° F to germinate and sustain growth. They are most impressive from late summer through the autumn when seeds are formed. Treat them as annuals.

Hardy Water Lilies

These differ from tropicals in that the tuber structure is a permanent part of the root system. In hardy varieties this tuberous structure is a rhizome, a thick fleshy root storage system that stores food for dormancy. The plant forms a clump which can be lifted and divided into several plants and should be divided every two or three years.

Hardy water lilies are frequently chosen for their strong colors. Some of the best varieties over the years have been:

'Attraction'. Large, red-flowered; easily grown throughout the country. Forms clumps in ponds and in large containers in pools.

'Comanche'. The larger version of the orange hardy lilies. An old favorite.

'Fabiola'. An excellent pink flower. It will remain small for tub garden use or grow to full size in larger spaces.

'Queen of Whites'. An improved pure white for use in pools of all sizes.

'Sioux'. A changeable orange flower of fairly small size. Opens yellow and grows darker with the passage of the days.

'Sunrise'. The largest-flowering yellow hardy lily. Starts early in the spring with numerous blooms most of the summer.

'Yellow Pygmy' (*Nymphaea* x *helvola*). A true dwarf variety. Excellent for limited spaces such as tub gardens.

Lotus

The next major group of aquatics that can be easily propagated is the lotus (*Nelumbo* spp.). Lotus are cold-hardy plants that grow and winter well throughout the country if their rootstocks do not freeze. These plants grow above the water's surface to 4 to 5 feet. This species is a vigorous grower that should not be planted in a pond or lake bottom where it will take over. They are best planted in large containers in pools or ponds. Tubers resemble a large banana and are formed in the soil in abundance as dormancy approaches. New plants can be started from tubers or seed. The seeds are very hard-coated and must be scarified (abraded) to germinate. In nature, lotus seeds remain viable but unsprouted for many years until chemical or bacterial action softens them. Scarification cuts the time to a few days. To scarify the seeds file the outer seed coat enough to weaken it so that water may enter. Use care not to file too deeply. Stop filing at the very first indication of the white inside. Sow the prepared seed in containers of soil. They will plant themselves as they sprout.

Other Aquatics

Shallow-water plants and bog plants can also be propagated in the home garden pool. Water iris, pickerel weed, giant papyrus, and other aquatics can be propagated by division. The umbrella palm and dwarf papyrus can be reproduced by dividing the roots of established clumps. Several of the shallow-water and bog aquatics multiply by runners spreading under the soil. Cattail, taro, and arrowhead are examples of this type. Most will also form viable seed that can be collected for later planting or left to seed themselves.

Floating and oxygenating plants are the remaining plants that complete the garden pool. They are among the most important in the overall scheme of things in the great benefits they provide their aquatic environment. The floating plants such as water lettuce (*Pistia stratiotes*) and duckweed (*Lemna*) provide surface shading which helps reduce algae problems by blocking sunlight at the water's surface. Algae grow in sunlight and use the available nutrients for survival. Therefore keeping down algae is important in helping further pool balance.

Even more important than floating plants are the oxygenating plants which grow under the surface of the water. Plants such as *Anacharis, Cabomba,* marestail, *Vallisneria,* and several of the submerged sagittarias are beneficial. They are effective in controlling the quality of the water by absorbing nutrients and carbon dioxide and releasing oxygen into the water as a by-product of photosynthesis (the sunlight-function-to-food of plant leaves). Murky waters clear in a surprisingly short time when oxygenating plants are at work. *Anacharis* and *Cabomba* can be propagated by cuttings of the growing tips. They are soft plants that root in a few days when potted in containers of soil in the bottom of the pool. They will also do well if simply weighted down to hold them in place. The marestail (*Ceratophyllum demersum*) can be dropped into the pool and remains neither planted nor floating but rather suspended in the pool depths. Its multi-branched structure continues to grow and may be broken into new plants. The vallisnerias and sagittarias require planting in soil either in containers or directly in the bottom of soil-bottom pools and ponds. They are grasses that multiply by soil-bound runners and fill in spaces between them much like the grasses in a lawn. The rapid growth of these plants accounts for their success in ridding the water of much of the problem algae, as well as being attractive. The oxygenating plants and the water lilies and floating plants are all important in balancing the conditions of the pool. ❦

All photos courtesy of Walt Disney World

The pool at the China Pavilion, Epcot Center

WATER GARDENING AT WALT DISNEY WORLD

D. Scott Schultz

Water gardening at Walt Disney World is a fairly new endeavor. Various water plants have been grown on the property but never to the extent afforded by the China Pavilion in Epcot Center. Two ponds were designed in the center of the landscape to capture the peace and beauty typical of a Chinese garden.

Pond Construction and Design

The two ponds are made of poured concrete four inches thick. Each one is forty-five feet wide and sixty feet long. They are separated by a twenty foot concrete walkway with three PVC pipes (6″ diameter) connecting the two below water level. The height of the sides varies from two to three feet, maintaining a water level of eighteen inches. Limestone rocks two to six feet in diameter were used along the edges and in the center of the ponds to help soften the concrete edges and to give the ponds a detailed look. This jagged edge with its many nooks and crannies makes the pond seem larger. Making the small seem large is one of the principles of Chinese design.

Another principle of Chinese design is the use of sound. The garden is a reflective place with its stillness interrupted only by natural sounds, such as rustling leaves or trickling water. This effect is achieved by a small waterfall located at the end of the south pond. A mound of rocks three to four feet above pond elevation forms a pool. This simulated spring flows down a series of embankments for twenty feet until it spills into the pond. This scene is observed from a three-foot-wide arched walkway that crosses the stream. Both ponds are surrounded by this walkway, which allows the observer an assortment of views and moods.

Water Management

Since the two ponds are connected by PVC pipe, they are treated as one in maintaining water quality and quantity. Water is added at the waterfall and recirculated through a series of filters and skimmers and pumped back to the top of the falls. One twelve-inch skimmer is located in each pond and cleaned daily of debris. In the bottom of each pond is a two-foot metal grate drain with a wire screen to help catch leaves and twigs.

To offset evaporation and leakage, make-up water is added at the pump. This valve is always left slightly open. If too much water is ever added, whether by this valve or rain, it is discharged through two overflow pipes that stand eighteen inches from the pond's bottom. Another benefit of this chlorinated water is to keep the ponds at the right clearness. If left to themselves, the ponds simply become so cloudy that the fish cannot be seen. This has to be closely monitored as too much chlorine could have an adverse effect on the fish.

Maintenance in a pool this size is conducted in fishing waders. Here the older or excess leaves are being trimmed and removed.

In well maintained pools, fish can be added. In this pool, the goldfish have increased tenfold in a matter of several years. Feeding and disease monitoring and treatment are important for the well-being of the fish.

Types of Water Plants

Three different types of water plants were added to the garden, *Nymphaea* spp., *Nelumbo* spp., and *Victoria amazonica* (see accompanying chart). The nymphaeas are tropical water lilies grown for their beautiful flowers and speckled leaves. These tropicals flower as long as the water temperature stays above 70° F and hold their leaves in the winter if the water temperature stays above 60°. The ponds generally look weak in the winter (January-March) but make a rapid comeback in the spring with heavy fertilization. Loss of water plants due to cold weather has varied from no loss up to 30-40 percent. New tubers can be added in the spring with no real loss to the garden.

The nelumbos, or Egyptian lotus, have long-petioled leaves that are held upright out of the water. This helps add a vertical element to the pond, as both the nymphaea and victoria pads lie flat on the water surface. Also, the nelumbos are not only attractive during flowering but produce an ornate seedpod afterwards. These have proven to be valuable in dried flower arrangements. The nelumbo tuber is completely hardy and comes back every spring.

Victoria plants have broad pads with a raised edge. These giants will grow a pad five to six feet in diameter under the right conditions. Our pads have been averaging eighteen to twenty-four inches. Fertilization and pot size are the limiting factors. Also, these saucers make a tremendous target for our guests and frequently are loaded with coins and holes. The victorias also may need to be replaced in the spring if the winter was severe.

Goldfish

The cultivation of fish in the ponds plays an integral part in the overall character of the garden. Their subtle movements are intriguing and enjoyable to all. Two types of goldfish were added, Fantail and Comet. Also, one black fish was added, a Moor. About three dozen of each were initially added, with our present population now about three hundred. A lot of crossbreeding has occurred, giving beautiful, mottled coloring. This population growth has been experienced despite the presence of several types of birds in the area that are natural predators.

Epcot Center List of China's Water Plants

Name	Flower	Time of Flowering	Distinguishing Characteristics
Nelumbo nucifera 'Asiatic'	White	Day	Chinese lotus, perennial—treated like annual
Nelumbo 'Egyptian'	Pink	Day	Chinese lotus, perennial—treated like annual
Nymphaea capensis	Navy blue	Day	Cape blue water lily or 'King of Blues'; deeply marbled leaves, large growth habit
Nymphaea 'Director George T. Moore'	Purple-blue	Day	Leaves flecked with purple, purple stamens, compact leaf growth
Nymphaea 'Pamela'	Light blue	Day	Flowers 10-12" in diameter, chestnut-marbled leaves, flowers are held high above leaves
Nymphaea 'August Koch'	Blue	Day	Viviparous (plantlets produced from mature leaves)
Nymphaea 'Trudy Slocum'	White	Night	Round leaves, pointed serrations, flowers very large, petals have blunt or rounded tips
Nymphaea 'George H. Pring'	Creamy white	Day	12-inch-wide leaves, large growth habit
Sagittaria montevidensis	White		Giant arrowhead, 2-1/2-foot-long spikes, 3 petals on flowers, cultivated vegetable in China; Indians called it Wapato. Central Florida native
Pontederia cordata	Blue		Pickerel-weed. Glossy heart-shaped leaves, edible seeds, cordate leaf base, wavy veins, 2-foot stems, flowers borne on spikes. Central Florida native
Cyperus alternifolius	(insignificant)		Umbrella flatsedge; upright stems up to 2 feet tall

Since the initial addition of the fish, very little has been done to maintain them. Once a week one to two cups of pelletized catfish food are thrown onto the pond's surface. This amount is increased or decreased depending on the relative size and health of the fish.

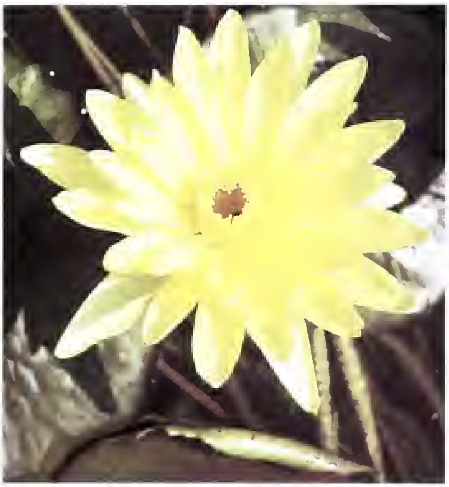
Plant Maintenance

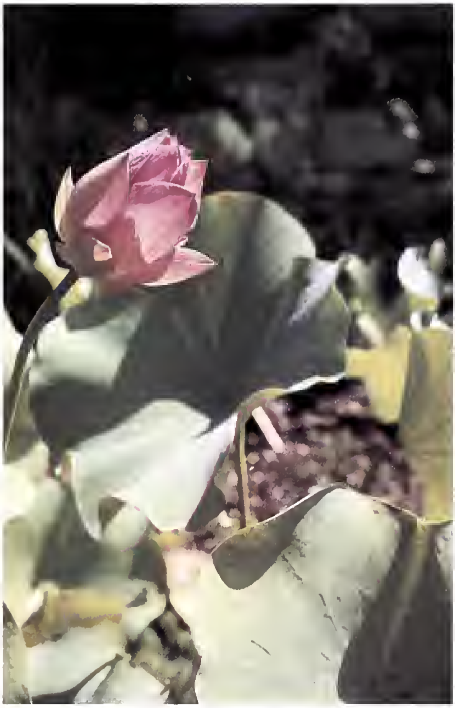
Each metal tub 24 inches wide by 10-1/2 inches deep contains one or two water lilies. They are planted in an organic soil with a two-inch layer of white sand on top. Generally we anticipate that the lilies will need to be repotted every two to three years.

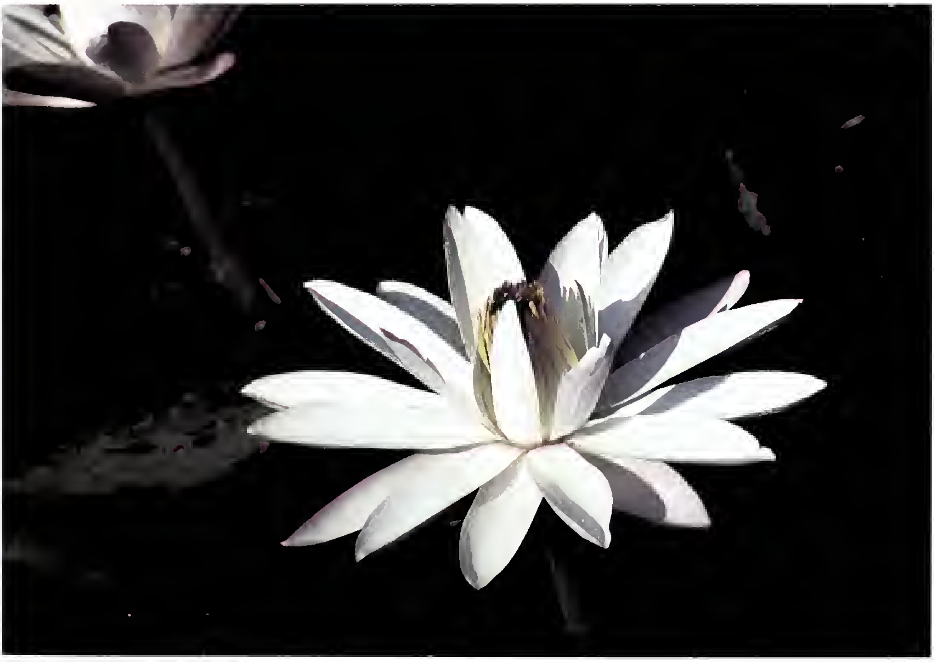
Weekly, fishing waders are donned to remove dead leaves and spent blossoms. These are cut rather than pulled so as not to injure the main plant. Most of the flowers last four to five days.

Fertilization is with an all-purpose shrub and tree fertilizer. Our analysis is 12-6-8 plus all the micronutrients. One-third of a cup of fertilizer is wrapped in a paper towel and plunged six to eight inches down into the pot. Three such balls are used per pot. This should be done every three to four weeks during the growing season. Fertilizer tablets have been used but proved less effective. Water lilies show nutritional deficiencies readily and should be kept in an active state of growth for best flowering. ♆

A Portfolio of Water and Waterside Plants and Gardens

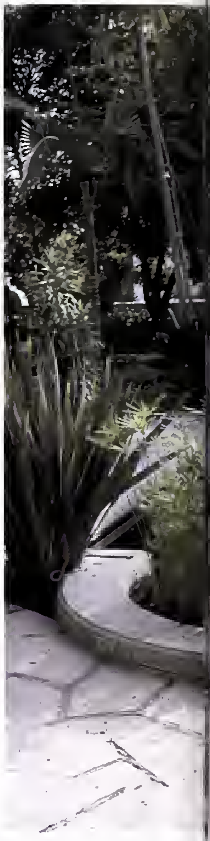






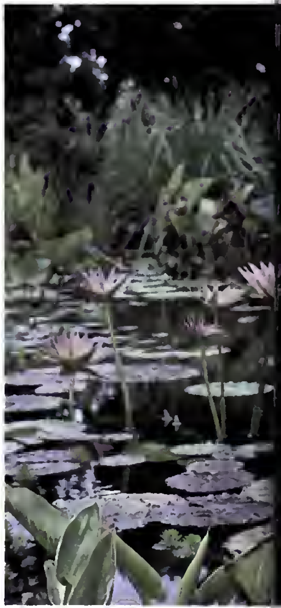
Above left: 'Yellow Dazzler', and excellent, prolific day-blooming tropical water lily. Above right: *Nelumbo nucifera,* the Egyptian lotus, is exotically fragrant. Below: 'Juno', a choice night-blooming tropical water lily.

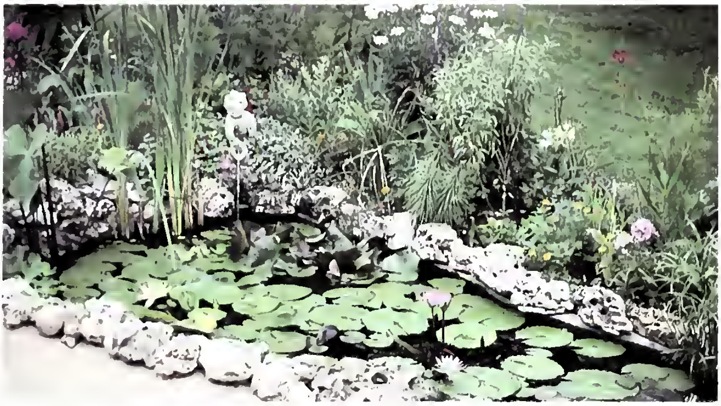
Above left: W. Tricker, Inc.; above right: J. Fanning; below: E. Ortner



Water Gardens in the Landscape

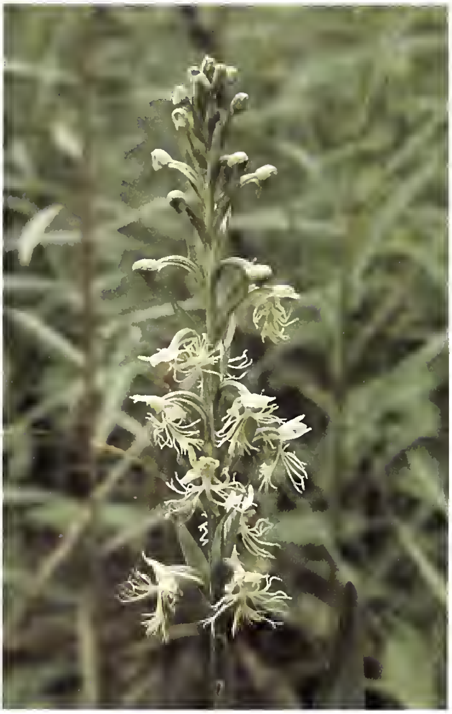
A water garden can be formal, informal, linear, round, or freeform; it can even be sunk into a deck. Perhaps the most intriguing aspect of a water garden is the play of light on it throughout the day and into the evening, changing the quality of color, reflection, even the illusion of depth.

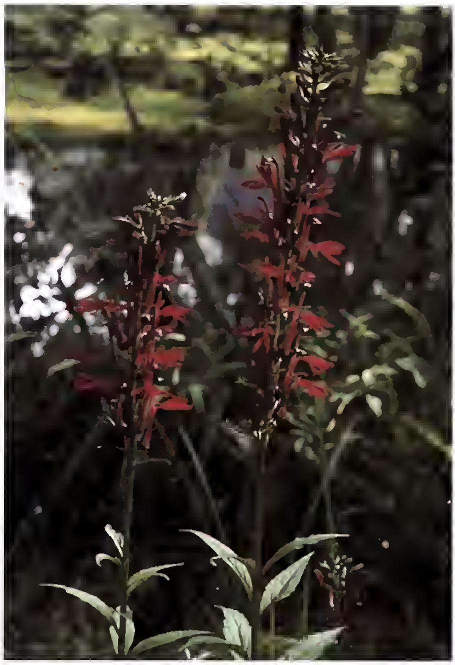


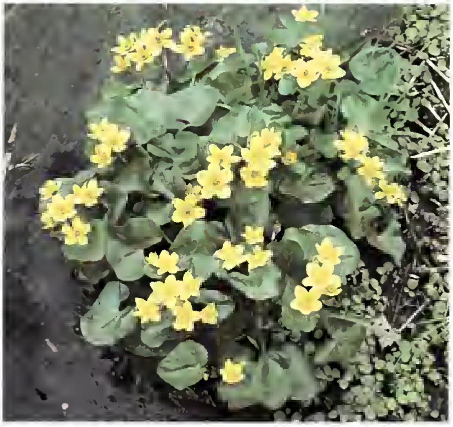


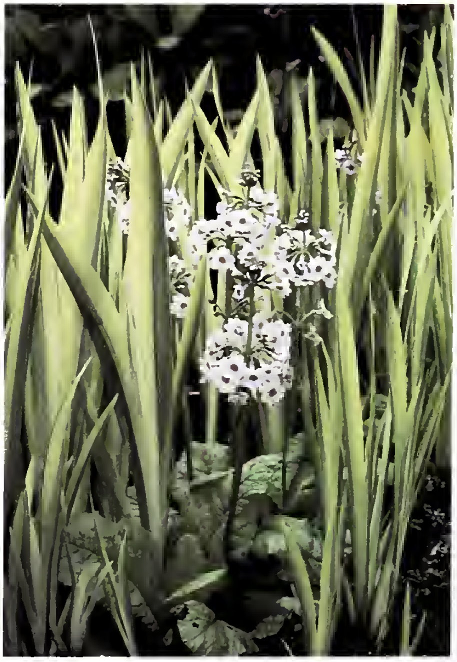
Top l. and c.: George Taloumis; others: W. Tucker Inc

Wildflowers for Wet Places







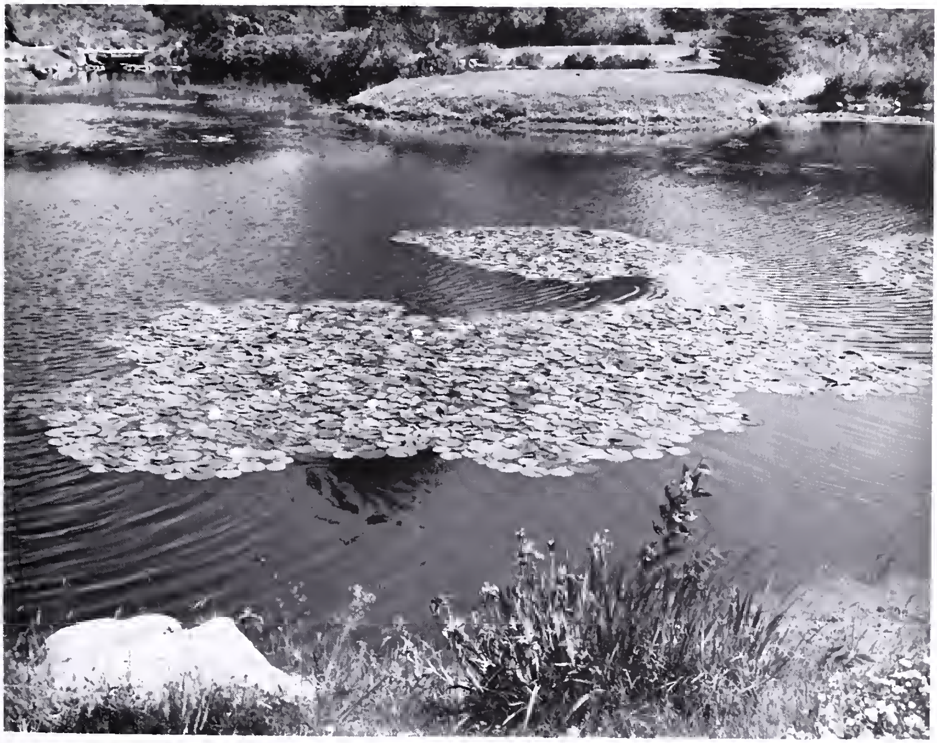


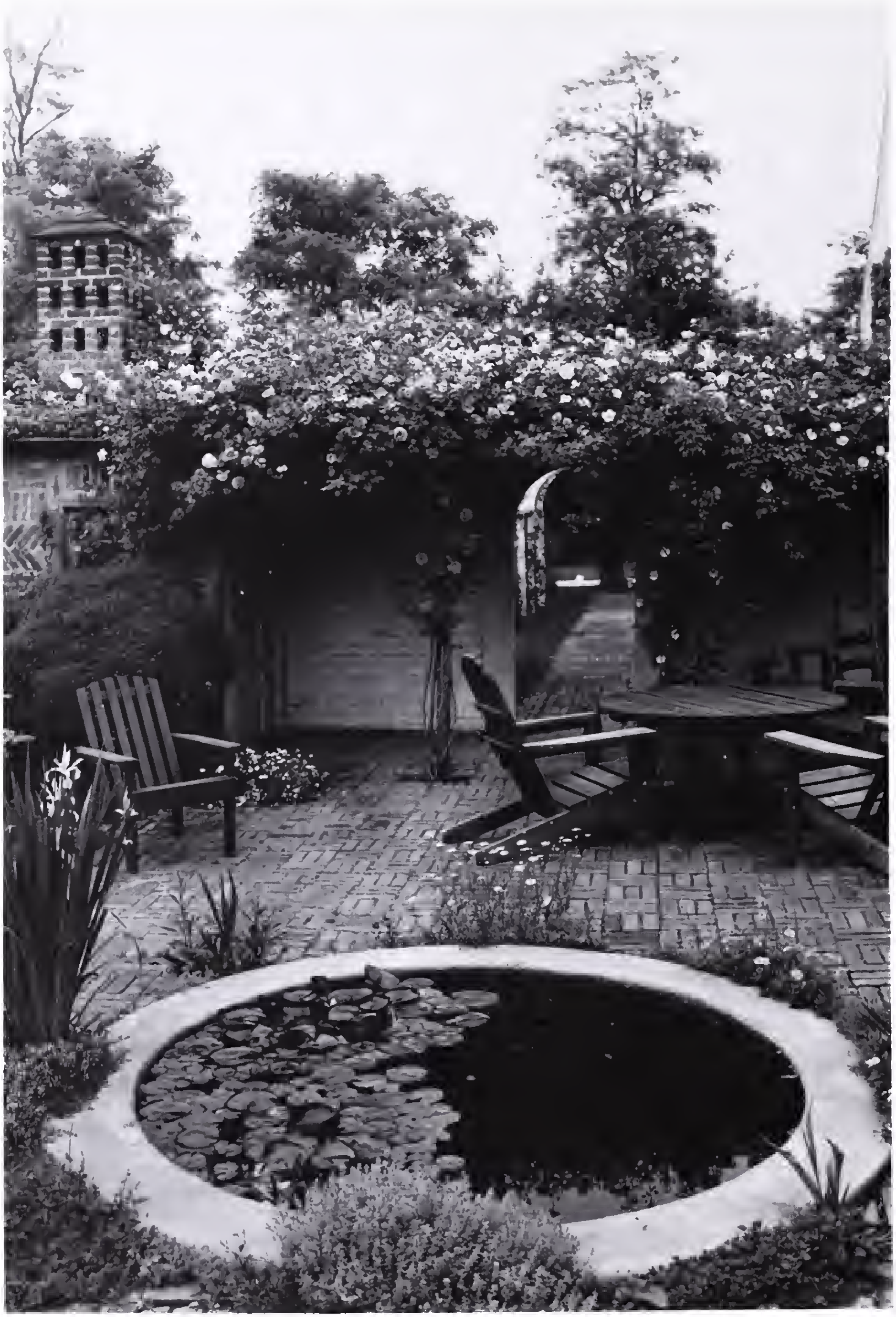
Above left: ragged fringed orchis (*Habenaria lacera*), a midsummer bloomer, likes a wet habitat similar to that where the cardinal-flower (*Lobelia cardinalis,* above right) thrives. Below left: the marsh-marigold (*Caltha palustris*) flowers in spring in swamps and at streamsides. Below right: the foliage of variegated yellow flag (*Iris pseudacorus variegatus*) frames a delicate *Primula japonica,* both growing in wet soil.

Above left and right: Gottscho-Schleisner; below left: Roche; below right: Pamela Harper

A small pool (right) planted with simple but handsome and vigorous plants including *Cyperus*, water hyacinth, and a pygmy water lily. Below, the hardy water lilies in this small lake grow in a graceful parabola because of the current of the stream feeding the lake.

Above: George Taloumis; below: Roche





A walled, paved courtyard, above, is softened by the presence of a small lily pool with herbs and iris planted around its rim. Right, above, a formal country garden combines the informality of a free-form pool with the austerity of reflection, unbroken by any plantings; the ultimate simplicity in a water feature in a garden. Below, hard angles of native rock are in marked contrast to the water lilies, iris, and grasses in this natural country pool.

Left: Gottscho-Schleisner; right above: Roche; below: George Taloumis

Photos from color slides by Pamela Harper

Marsh marigold (*Caltha palustris*)

PERENNIALS FOR WET PLACES

Pamela J. Harper

Quite a few perennials are adapted to marshy ground, and some can be grown in shallow water. A low-lying part of the garden that remains swampy could be turned to good account by growing those perennials that, in the wild, grow along the banks of streams, the margins of ponds, or in low-lying boggy places. Most of them can also be grown in ordinary soil that does not dry out, but they are at their most luxuriant where moisture is abundantly and constantly available.

If such an area does not exist, it can be created by digging out soil to a two-foot depth, lining the hole with heavy plastic, pricking this with a garden fork so that excess water can slowly escape (it is a bog you are making, not a pond), and replacing the soil mixed half-and-half with peat moss or leafmold. If the soil is poor, add some well-rotted cow manure. Most bog plants prefer acid soil, so don't add lime. Such a plastic-lined hole can quickly be remoistened when necessary with the garden hose. On a smaller scale, you can use a sunken plastic laundry tub a foot or more deep.

If a stream runs through your garden, the moist banks provide an ideal site for such plants if the water level remains fairly constant, but if it alternates between stream, dry ditch, and raging torrent, it is not a suitable place for plants unless a means can be found to control the flow of water.

If a pool is to be constructed, the deep central part can be surrounded by a shallower trough with its inner edge lower than the outer one, this trough being filled with soil in which to grow bog-type plants.

Plastic sheeting has made the construction of this kind of pond comparatively simple: there are excellent photographs and instructions showing how to do it in the catalogs of Lilypons Water Gardens and William Tricker, Inc. (see p. 64). Preformed pools, formal or free form, can also be bought.

Smaller Perennials

Obviously the plants chosen should be of a size in proportion with their surroundings. For the smallest pools the marsh marigold or kingcup, *Caltha palustris,* heads my list. It makes substantial but compact clumps of dark green, glossy round leaves, and in spring the bright yellow waxy flowers turn it to a golden mound. *C.p.* 'Flore Pleno' is the showiest, the yellow pompoms touched with green in the middle. There is also a white form, 'Alba'.

For contrast in form try *Acorus gramineus* 'Variegatus', a Japanese sweet flag with slender, white-striped irislike leaves twelve to eighteen inches long, evergreen in the milder regions. If you like the quaint and curious, then add *Juncus effusus* 'Spiralis', an eighteen-inch rush with dark green cylindrical leaves corkscrewed as if they'd been given a permanent wave.

Irises

When we come to perennials of larger proportions, many gardeners will think first of Japanese irises (*Iris ensata,* formerly called *I. kaempferi*), so often seen displayed in shallow water in public gardens. Look closer and you'll probably find that they are being grown in pots, to facilitate removal when they go dormant and need well-drained soil. The best place for Japanese irises is a humus-rich, moist but well-drained bed or border. If you see what you think is a Japanese iris growing in water the year around, it is probably the similar two-foot *I. laevigata,* with flowers of blue, white, rose, or violet. This needs constant moisture and is at its best in a bog, or with roots under water at the pond margin. The lavender-blue flowers of *I. laevigata* 'Variegata' last no longer than any other iris—just a week or two—but the creamy-striped leaves make this one of the most lastingly decorative plants for the pondside.

The easiest of all irises to grow in boggy soil or shallow water is the yellow flag, *I. pseudacorus.* This is not a native plant, but it has naturalized in many parts of

Iris pseudacorus, the classic yellow flag, is a naturalized European iris that grows readily in shallow water or boggy spots.

Roche

Ostrich fern (*Matteuccia pensylvanica*) is not only a handsome and willing grower in wet areas, it also can be used to retain soil along a stream or pond edge.

North America and may do the same in your garden if you let seedpods form. It varies in height from two to seven feet, with single or double flowers of bright yellow, lemon, or ivory. The leaves of *I.p.* 'Variegata' are showily striped yellow in spring but turn green by midsummer. Other irises adapted to marshy ground and shallow water are *I. prismatica, I. versicolor, I. virginica,* and the species and hybrids known as Louisiana irises.

Primroses and Ligularias

Primroses are among the prettiest perennials for boggy soil. These are not the woodland kinds, nor the ones called polyanthus, but those usually called Japanese primroses, with whorls of flowers spaced along stems from one to four feet high. Species include *Primula beesiana, P. bulleyana, P. florindae, P. helodoxa, P. japonica,* and *P. pulverulenta.* Colors include rosy pinks, crimson, yellow, orange, and purple. All flower in late spring or early summer. *P. japonica* is best known, to two feet, with flowers of white, rose, crimson, or purple. 'Miller's Crimson' and 'Postford White' are excellent selected forms. These bog-type primroses appreciate light shade, and this is essential in the hottest parts of the U.S. A lovely companion for them is the Ostrich fern, *Matteuccia struthiopteris,* a three- to five-foot shuttlecock of ostrich-plume leaves.

All the ligularias need moist or boggy soil, otherwise the leaves wilt miserably on sunny afternoons. *L. dentata* 'Othello' and *L.d.* 'Desdemona' are similar plants, grown mainly for their hefty three- to four-foot clumps of large, heart-shaped dark green leaves with mahogany undersides. Bright orange ragged daisies open late in the season on stout branched stems. If you are of the many who don't like orange with maroon, you may prefer to remove the flowers, or grow instead *L. przewalskii, L. stenocephala,* or *L.* 'The Rocket'. These are similar and confused. They bear tall spires of yellow flowers on purple or nearly black stems over substantial clumps of jagged or deeply incised leaves.

And Others

The following perennials all do well in moist to wet soils:

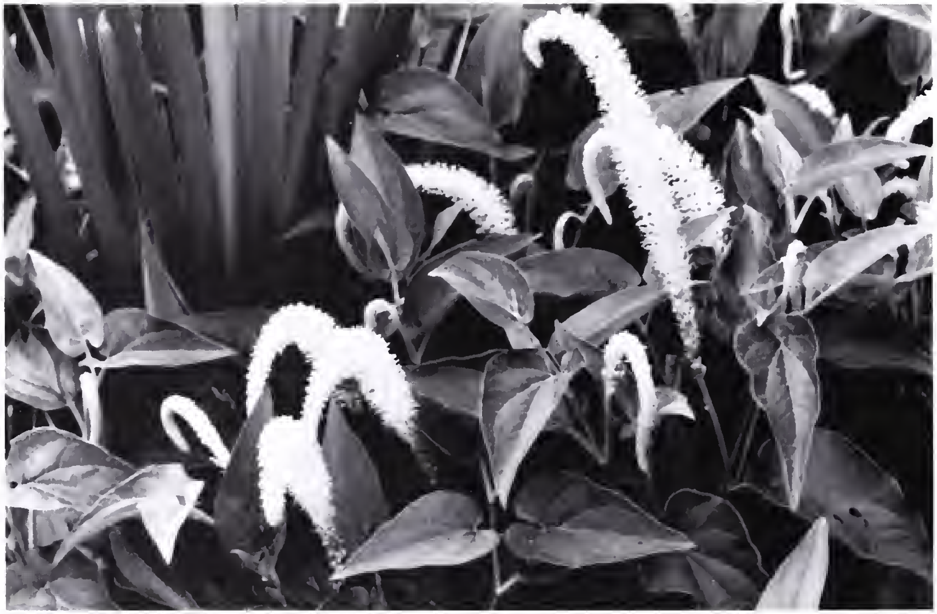
Arisaema triphyllum (Jack-in-the-Pulpit) (needs shade)
Astilbe
Chelone glabra (Turtlehead)
Eupatorium fistulosum (Goat's beard)
Eupatorium purpureum (Joe-Pye weed)
Filipendula palmata (Meadowsweet)
F. ulmaria (Queen-of-the-Meadow)
Helenium autumnale (Sneezeweed)
Lobelia cardinalis (Cardinal flower)
Lysichiton (Skunk cabbage) (needs light shade)
Lysimachia punctata (Loosestrife)
Orontium aquaticum (Golden-club)
Peltiphyllum peltatum (Umbrella plant)
Ranunculus repens ('Flore Pleno', double, is the most ornamental) (Butter daisy)
Rodgersia
Sanguisorba canadensis (Canadian burnet)
Trollius (Globeflower)
Veratrum (False hellebore) (light shade)
Vernonia (Ironweed)
Zantedeschia aethiopica (Calla-lily)

American burnet (*Sanguisorba canadensis*) blooms late in the season with creamy spikes of florets. In boggy areas with good sun the plants can grow to six feet.

All these are available either from nurseries selling perennials or from wildflower nurseries.

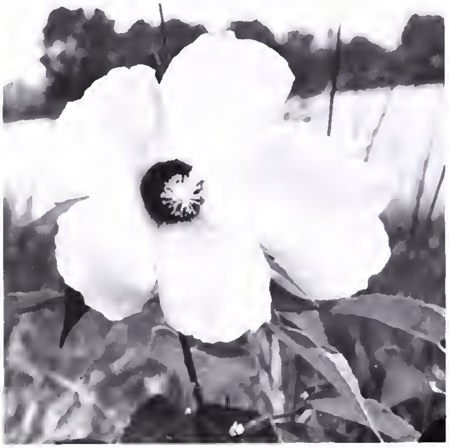
If you have a large area of untamed boggy ground, look through wildflower books for your region to find flowers you like that are sufficiently robust to compete with grass and other vegetation. Without such competition, and sometimes in spite of it, some of these spread very rapidly. Purple loosestrife (*Lythrum salicaria*), for example, is a European introduction that has ousted native-born plants from many a wet East Coast meadow. Lizard's tail or water dragon (*Saururus cernuus*) is another vigorous colonizer of swamps and shallow water, native from Quebec and Ontario south to Florida and Texas. It is likely to do well in sites where cattails grow. Over

Rodgersia podophylla thrives in moist or marshy soil, producing very large leaves that are impressive but not easy to integrate in any but the larger gardens. It is well worth trying if you have the room, because its bronze-green leaves can exceed a foot across.



Saururus cernuus, the lizard's tail or water dragon, will readily colonize shallow water areas. Its arched flower stalks are slightly fragrant.

heart-shaped leaves up to six inches long rise arched tails of slightly fragrant white flowers. Similar white arched clusters, but shorter, and on taller plants are found on the three-foot Japanese loosestrife or gooseneck, *Lysimachia clethroides,* which spreads rapidly in moist soil.



The shrublike swamp rose-mallow (*Hibiscus moscheutos*) is actually herbaceous, achieving its three to six foot growth from the roots each year.

Those who garden on the banks of creeks and inlets need plants that can tolerate brackish water. Several lovely mallows are native to such sites. Swamp rose-mallow, *Hibiscus moscheutos,* bears four-inch white-petalled flowers with a crimson eye on three-to-six-foot bushes. Saltmarsh-mallow, *H.m. palustris,* sometimes called Sea hollyhock, is similar but the flowers are pink. Seashore mallow, *Kosteletzkya virginica,* is a daintier plant with two-inch pale pink flowers. The most impressive, but less hardy than the others, is *Hibiscus coccineus,* which has deeply lobed leaves and bright red flowers four to five inches across. In wet soil it may reach eight feet in height. All these mallows flower in late summer or early autumn. They are at their best with abundant moisture but also tolerate quite dry soil.

Those who garden, as I do, on tidal creeks, should get acquainted with the sea ox-eye, *Borrichia frutescens.* This has half-inch wide yellow daisies with short, widely spaced ray petals. It is not a "wow" sort of plant, but the fleshy glaucous leaves are attractive and this is one of the few plants that tolerate being two feet or more under salty water when the tide is in. ❦

AQUATICS—THE SCOPE OF WATER PLANTS

Thomas J. Delendick

What is an aquatic plant? Simply, it is a plant that grows in water.

If this is so, why do manuals of aquatic plants, like Fassett's and Prescott's (see list of references, p. 64), include such dry-land plants as maples, viburnums, and willows? Because the needs and definitions of an aquarium enthusiast, a home gardener with a small pond, and a vacationer, hiker, or wildlife biologist exploring a lake, bog, or swamp are all different. And most of the manuals that exist deal primarily with the local temperate flora and have the last-mentioned users specifically in mind.

One of the problems in defining aquatic plants centers on the old saw, "Nature mocks men's categories." It is necessary to have a framework in which to organize the body of facts that have accumulated. But it is necessary also to bear in mind that the organization, though convenient, does not fully reflect the complexity of the biological world. In the case of aquatic plants, there is a continuum of "aquatic" habitats from the depths of a lake or stream through swamp, bog, marsh, and seasonally wet hollows and meadows, before one comes up on dry land. And the plants pass variously from one habitat to the next.

For convenience, most water plants will fit into one of five categories. Four of these have an ecological basis; the fifth is distinctly artificial, but by knowing something about a species' natural habits/habitats, it is possible to select plants for a specific water garden or aquarium situation and so increase the chances for success.

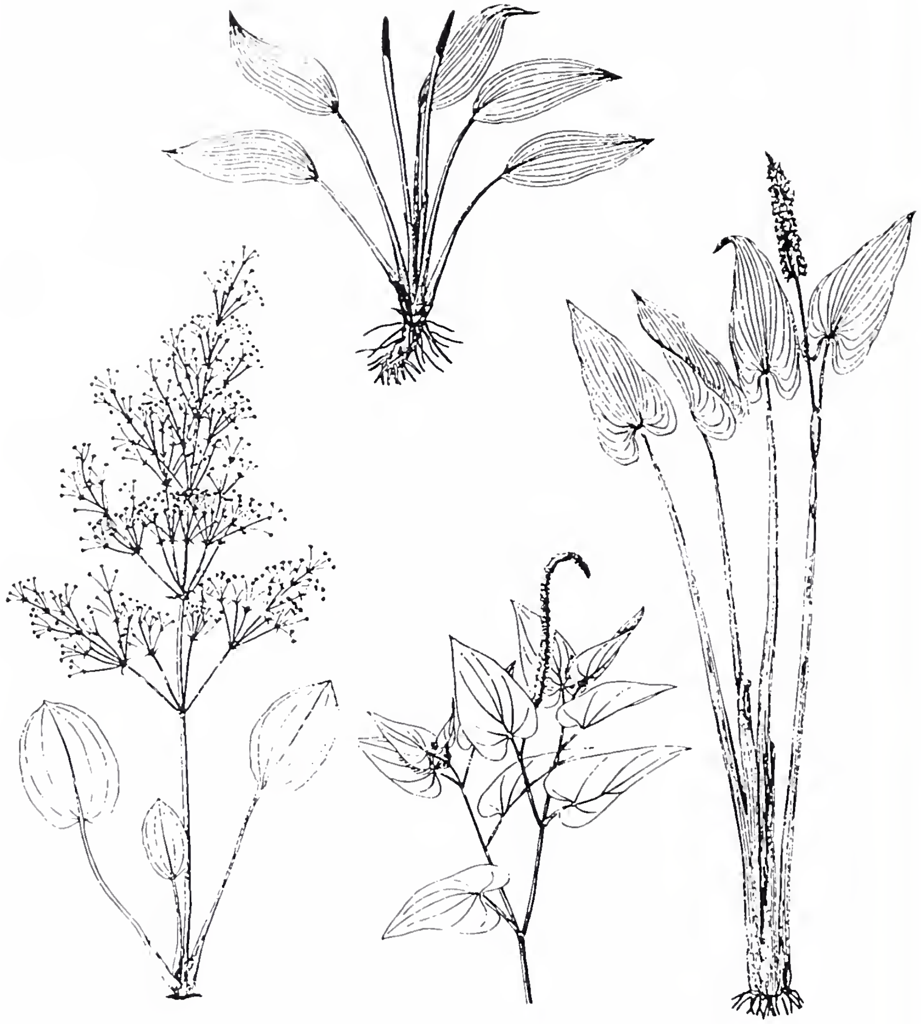
Submerged Aquatics

These include those species which actually live underwater for all or nearly all of their natural life cycle. They are rooted in the bottom of the pond/stream/tank, with their stems and leaves submerged, although in some the stems may lengthen to the extent that they "float" beneath the air-water interface. In some submerged aquatics, floating leaves are produced at flowering time.

This group is fairly large and the biology of its members is rather varied. Take, for instance, water-weed (*Elodea canadensis*) (also known as ditch-moss and frog-bit), a North American native which is a common aquarium plant. Although pieces of stem may break off and become free-floating, *Elodea* is basically an underwater plant. The flowers are produced in the axils (the angle between the leaf and the stem) of the leaf and, when ready for pollination, are "released." At that time the male flowers are set free from the plant to float on the water surface; the female flowers rise to the surface on elongating pedicels (flower stalks) which, after pollination, coil and draw the spent flower down into the leaf axil. The fruit matures underwater. Eel-grass (*Vallisneria americana*) is closely related to water-weed, although its vegetative appearance is very different.

In contrast, the water starwort (*Callitriche* spp.), so named because when fully developed it produces a rosette of floating leaves, has flowers which develop and are pollinated entirely underwater. The various species of pondweed (*Potamogeton*) are essentially submerged but often produce floating leaves before the aerial inflorescences (flower clusters) appear. Many are interesting and attractive; some have an unfortunate tendency to become weedy.

Quillworts (*Isoetes* spp.) are relatives of the ferns; they look like underwater grasses



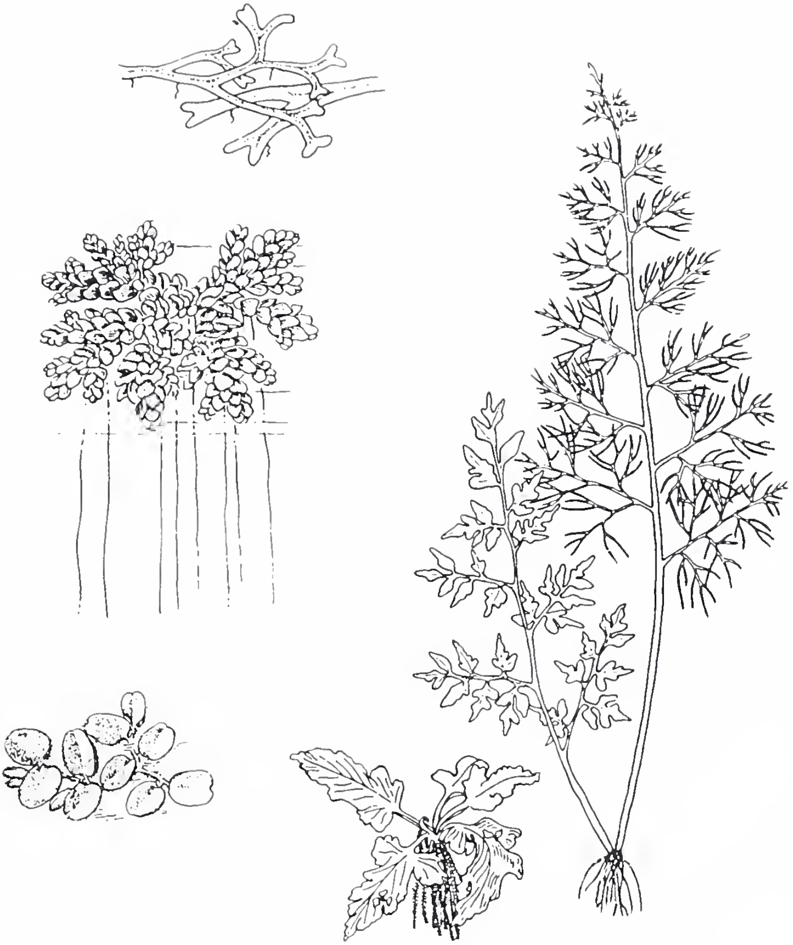
Courtesy of the author

Clockwise from top: golden club (*Orontium aquaticum*); pickerel weed (*Pontederia cordata*); lizard's tail (*Saururus cernuus*); water-plantain (*Alisma subcordatum*).

or sedges but, fernlike, reproduce by means of spores which are produced in sacs at the base of the quill-like "fronds." The fountain moss (*Fontinalis antipyretica*) is one of the few truly aquatic mosses; all members of the genus pass their lives in cold, fast-flowing streams. The cultivated algae are also obligate submergents, including hair-grass (*Nitella* spp.) and stonewort (*Chara* spp.).

Emergent Aquatics

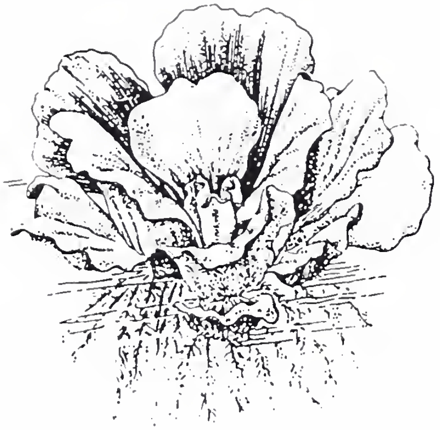
These include those aquatics which are rooted in the substrate (bottom) of their aquatic habitat, but typically produce aerial stems and foliage, although some have only floating leaves. Flowers are produced above the water surface. This is the largest group of aquatics and the most diverse. Delimitation of this category is complicated by the fact that in the wild state some emergents "emerge" by shoot growth above the water surface while the roots and lower stems are in relatively deep water; other emergent species need to have their "feet" wet, but the substrate may be no more than a soggy or marshy habitat with no



Clockwise from top: crystalword (*Riccia fluitans*); water-sprite (*Ceratopteris thalictroides*) emergent phase and (left) floating phase; floating fern (*Salvinia natans*); mosquito fern (*Azolla filiculoides*).

depth of water to speak of; still others depend for their "emergence" on seasonal fluctuations in the water level of the pond or stream they live in.

Here are found plants like the water lilies (*Nymphaea* spp.) and the sacred lotus (*Nelumbo* spp.) which require a certain minimum depth of water in order to survive the winter (there is a maximum depth, too, below which they will not grow). Both produce floating leaves. The lotus typically produces aerial leaves as the season progresses, but water lilies only when crowded. Water lily-mimics include the floating-hearts and water-snowflakes, members of the genus *Nymphoides*. These resemble *Nymphaea* vegetatively, but their flowers have only five petals and these are somewhat fused at the base—they are in fact more closely related to gentians. *Trapa natans*, one of the water-chestnuts, is a somewhat unique emergent, with highly dissected and threadlike submerged leaves plus a rosette of floating leaves which bear flowers in their axils. They start off life connected to the submerged fruit but with age the connection may be severed and the water-chestnut will float.



Water-lettuce (*Pistia stratoites*), an aroid, has flowers similar to anthuriums.

Among the "more emergent" emergents are many species of great ecological importance, such as cattails (*Typhia* spp.), wild rice (*Zizania aquatica*), and a great many ornamentals. Among the last are the native American golden-club (*Orontium aquaticum*), an aroid with conspicuous yellow flower clusters. Golden-club may be found in water up to a foot deep or growing practically on mud flats. Pickerelweed (*Pontederia cordata*) has erect clusters of heavenly blue flowers. Water-plantain (*Alisma* spp.), with airy panicles of tiny white flowers, is somewhat reminiscent of baby's-breath. Lizard's-tail (*Saururus cernuus*) has nodding racemes of white flowers. Many species of *Echinodorus*, the sword-plants of aquarists, thrive underwater, but in the wild are essentially emergent and even in cultivation send up aerial leaves and shoots when they reach reproductive maturity.

Many of the most important and ornamental aquarium plants are emergents, such as *Anubias* spp., *Cryptocoryne* spp. (the "crypts"), and *Aponogeton* spp. (including the Madagascar lace plant). They are grown submerged, but since they are attuned to a natural annual cycle of wet/dry or cool/hot seasons in their native habitats they are among the most difficult to keep in cultivation for extended periods.

Floating Aquatics

These include those species which are not rooted in the substrate and are free-floating on or below the surface of the water. Occasionally floaters may be "beached" by wave action or a fall in the water level. Among the flowering plants which are floaters are the bladderwort (*Utricularia* spp.), one of the "carnivorous" plants, which traps and digests water fleas and other minute aquatic animals in its submerged bladders; water-hyacinth (*Eichhornia crassipes*) which has such a bad reputation as a pest in tropical and subtropical waterways; water-lettuce (*Pistia stratiotes*), an aroid and thus a relative of philodendrons and anthuriums; and the duckweeds, *Lemna* spp., *Wolffia* spp., and their relatives—ultra-reduced derivatives of the aroids which include the smallest of all flowering plants.

Opportunistic or Occasional Aquatics

These have a predilection for a moist habitat (lake or river bank) and are subjected to periodic or seasonal changes of water level. Some of these merely tolerate temporary submergence of their roots and stems; others may be found more or less commonly as shallow-water emergents; most can be cultivated in a well-drained situation.

This is where we would put the red and silver maples, viburnums, willows, etc., of the aquatic plant manuals. Bald-cypress (*Taxodium distichum*), which is commonly thought of as a southern swamp tree but which is quite as happy in non-aquatic situations, falls in this category. Several species of *Iris* and a number of ferns such as ostrich fern (*Matteuccia*), sensitive fern (*Onoclea*), and royal, cinnamon, and interrupted ferns (all of the genus *Osmunda*) are also here, along with most marsh and bog plants (the insectivorous pitcher-plants and sundews). ❦

Sweet-flag (*Acorus calamus*)

PLANTINGS FOR PONDS, LAKES AND STREAMS

Bill Kester

The following information is of interest mainly to persons who are fortunate enough to own or have access to wetlands adjacent to lakes, rivers, or streams, or to people who have constructed, or are contemplating constructing, a pond or lake on their property.

Many of these aquatic plants are a necessity in making sure that the pond or lake will remain clear, healthy, and full of living creatures. Through the process of photosynthesis, living plants are able to turn carbon dioxide in the water and the air into carbohydrates for their own use by the action of the sunlight on its chlorophyll. Therefore, they purify the water, release vitally needed oxygen into the air and water, provide shade from the sun's rays in warm weather, and bind the bottom soils. It is very seldom that a pond or lake will remain muddy if it contains plants.

Plants also provide excellent cover for young fish and waterfowl. Insects, crustaceans, plankton, and other organisms and animal life abound and reproduce rapidly on and among these plants, thus providing

Watercress (*Nasturtium officinale*) grows well in moving water. It is an annual that readily reseeds.

food for fish, waterfowl, and some mammals. Many of these plants are valuable sources of food in the form of seeds, nutlets, tubers, fruits, roots, and foliage that is needed for waterfowl, upland birds, and mammals. Following is a list of some of the plants you can plant in and around your ponds, lakes, or wetlands, with a brief description of how, where, and when to plant and of their value to wildlife and the environment.

Sweet flag (*Acorus calamus*). Plant in the same conditions as iris. Its flower is unusual—it grows from the side of one of its leaf stalks and the resulting seed head resembles a cattail head. The leaves are lemony and the roots have a sweet spicy aromatic fragrance.

Swamp milkweed (*Asclepias incarnata*). Pretty perennial with rose-purple flowers followed by long narrow seed pods that split open like the upland milkweed. Plant any time in damp soil. Grows to a height of about 3 feet.

Sedge (*Carex* spp.). Prefers shallow ponds, sloughs, or marshes. It has a three-sided stem, and varies in height from 18 inches to 3 feet. It provides a dense root system for binding the soil. It has a pretty ornamental seed head, but not much food value. Perennial; plant any time of the year.

Spike rush (*Eleocharis acicularis*). Perennial; plant any time of year. Grows best in shallow water, muddy flats, swales, and marshes in ponds, lakes, or streams throughout the United States. Small round-stemmed plant growing from 8 to 18 inches high.

Joe-Pye weed (*Eupatorium*). Perennial wetland flower with purplish flowers which grow to a height of 3 to 4 feet. The rootstock can be planted any time in damp soil.

Blue and yellow water irises (*Iris germanica*). Prefer damp soil or shallow water, but will tolerate soil that later dries out. Plant on borders of ponds, lakes, streams, or marshy areas. Have beautiful blue or yellow flowers and lancelike leaves. Most are ornamental perennials and can be planted any time.

Watercress (*Nasturtium officinale*). Prefers spring-fed brooks and ponds. Excellent food for humans and waterfowl. As the seed is very fine, almost like pepper, we suggest mixing with dry sand when planting. An annual, but reseeds itself.

American lotus (*Nelumbo lutea*). Prefers shallow-water bays and sluggish streams or lakes. Indians used the seeds and tubers for food. A perennial and ornamental. (See p. 19.)

Wild water lily or Spatterdock (*Nuphar advena*). Grows in shallow protected areas of ponds, lakes, or streams. Has a large rootstock, 4 to 6 inches in diameter. This is a perennial and can be planted any time. Ornamental.

Magnolia water lily (*Nymphaea tuberosa*). Grows best in shallow water 1 to 2-feet-deep in ponds, lakes and in the sheltered bays of streams. The lily has a parent rootstock that resembles a banana with small tubers (about 3/4 inch in diameter and 3 to 4 inches in length) fastened to it. If you want flowers the first year, the large parent rootstock should be planted because the small tuber may not bloom for several years. Provides excellent cover for fish, especially bass, as they wait for a frog to jump off the lily pad. Available in white and many colors and all are perennials.

Reed or Cane (*Phragmites* spp.). Stalks have hollow sections similar to a cane fishing pole. It grows up to 8 feet and provides shelter for all wildlife. Perennial; plant any time of the year in wet soils along ponds, lakes, streams, or marshes.

Nodding smartweed (*Polygonum punctatum*). Plant root sections at any time of the year in damp soil, and in water up to 10 inches deep. Provides some cover for wildlife, but usually matures to about two feet high. Produces some small round flat black seeds that waterfowl and upland game birds eat. It produces an amazing thick network of running ropelike roots. These roots are about the thickness of a pencil and I have seen them 20 to 30 feet long—very good for erosion control. Survives drought as well as periodic flooding after it becomes established.

Pickerel weed (*Pontederia cordata*). Besides being a good cover plant for fish, this beautiful ornamental has a spike of bright blue flowers and heart-shaped leaves. It is a perennial. Plant in water 1 or 2 feet deep at any time of the year. Its seeds are also eaten by waterfowl. It can be planted in ponds or lakes.

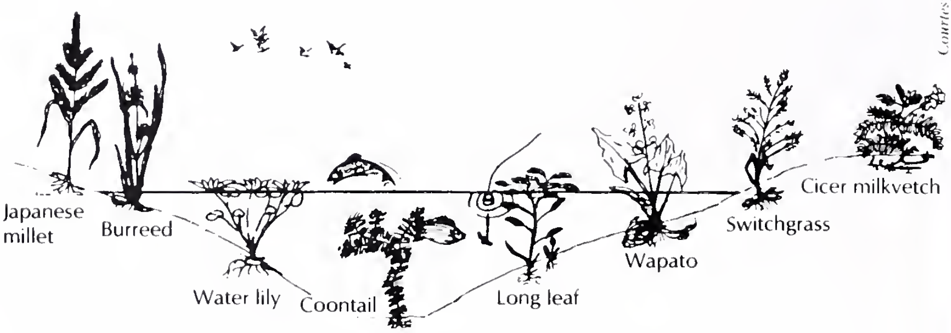
Sago pondweed (*Potamogeton pectinatus*). Plant in water 1 to 3 feet deep from early spring through summer, or later in the southern states, as long as you have about 100 days for it to mature. It grows in almost any waters, including small ponds, throughout the United States, but not in strong salty waters. It produces tubers in the soil, as well as setting seed, and both are excellent food for waterfowl. The foliage provides cover for fish and purifies and clarifies the water. As these tubers float they must be weighted in some manner to keep them at the bottom of the pond or lake so they can take root.

Arrowhead, Wapato or duck potato (*Sagittaria latifolia*). Plant in spring and summer on wet mud flats and in water up to 18 inches deep; requires about 120 days of growing weather. Arrowhead will grow in small ponds, lakes, or streams. However, in large lakes it needs protection from wave action. Plant in sheltered bays or coves, or where there are bulrushes or reeds. They grow well in most inland waters except those tainted with strong lime, alkali, or salt. Arrowhead is excellent for planting as a bed for filtering polluted waters, as it is one of the heaviest feeders of rich nutrients. The richer, more fertile the soil, the larger the plant will grow. In high nutrient areas it will produce 2- or 3-inch tubers similar to domestic potato; the size of the tuber in non-fertile waters will range from a marble to golf ball size. The color of the tubers will vary from white to cream, red, blue, or purple. Because of its high starch content, this tuber is one of the best muskrat foods. The tubers and crisp parts of the plant are valuable waterfowl food. The large tubers were a staple food for the Indians who showed the early settlers how to use them. The early Chinese immigrants used the tubers for starch in their laundries and also considered them a very healthy table vegetable. The leaf is shaped like an arrow and the plant has a white blossom.

M. Joyner

Arrowhead (*Sagittaria latifolia*) is a heavy feeder that will do well in areas rich in dissolved phosphates and nitrates if the water movement is not too swift.

Below is a pictorial view of a suggested planting, showing where to plant various aquatic plants.



Courtesy of author

Plant in Damp to Dry Soils

Switchgrass
Reed canary grass
False bittersweet
Jerusalem artichoke

Plant in Damp to Muddy Soils

Blue water iris
Yellow water iris
Sweet flag
Japanese millet
Browntop millet
Lowland smartweed
Millet
Sesbania
Alkali bulrush

Plant in Water 1–10 inches

Burreed
Nodding smartweed
Three-square rush
Cattail
Wampee duck corn
Watercress

Plant in Water 4–6 inches

American lotus

Plant in Water 1–18 inches deep

Arrowhead
Wild rice
Tame rice
Bulrush
Pickerel weed

Plant in Water 1–3 feet deep

Sago pondweed
Wild celery
Long-leaf pondweed
Redhead grass

Plant in Water 1–2 feet deep

Deep-water duck potato
Water lilies

Plant in Water 1–6 feet deep

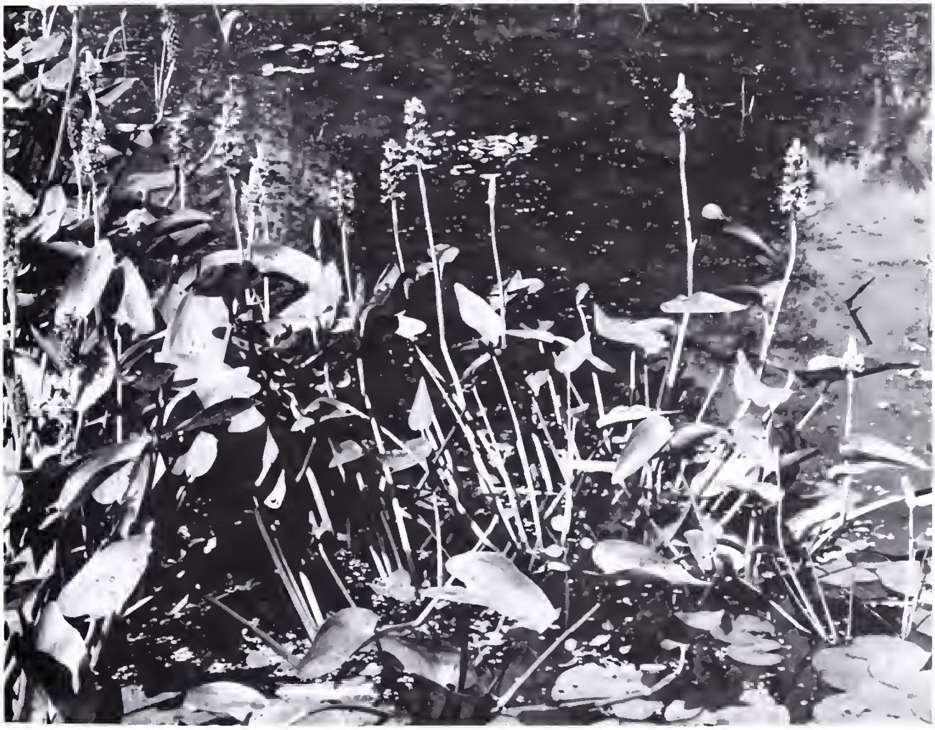
Coontail
Elodea
Naiad
Muskgrass
Ducksmeat

Plant in Dry Soils of Ditch Banks and Surrounding Soils
(soil to be worked up and planted)

Cicer milkvetch
Birdsfoot trefoil
Crownvetch
Wild white clover
Coniferous trees
Mixed game bird seed
Deer plot mix seed
Pearl millet
Proso millet
Milo
Tioga deer tongue
Small burnet
Hegari
Dove proso millet
Duckwheat
Lespedeza
Kester's peas
Field peas
Winter wheat
Buckwheat
Perennial grain
Lathco flat pea
Aeschynomene

M. Joyner

Joe-Pye weed (*Eupatorium dubium*), above, thrives in damp soil, growing to a height of three to four feet with large purplish flower heads. Pickerel weed (*Pontederia cordata*), below, has spikes of blue flowers the same color intensity as its leaves.



Gottscho-Schleisner

Deep-water duck potato (*Sagittaria rigida*). Plant in water 1 to 2 feet deep in spring and summer; requires 120 days for maturing. Not suited for small ponds as it prefers moving or slow flowing streams, sloughs, large ponds, or lakes. The leaves are the shape of a chicken-wing feather and the plant produces small yellow tubers which are another favorite food of waterfowl.

Hard-stem bulrush (*Scirpus acutus*) and **Soft-stem bulrush** (*S. validus*). Plant at any time of the year in wet soils, and in water up to 18 inches deep. Foliage is a hollow tubelike stem that grows 3 to 5 feet tall, tapered on the end. It produces seed that is eaten by waterfowl, and muskrats will feed on some of the roots and also use the foliage for house building. When growing some distance out from the shoreline, it provides a buffer zone that breaks the wave action. This deters shoreline erosion, quiets the waters, and allows other food-producing aquatics such as wild celery, sago pondweed, deep-water duck potato and arrowhead to grow. Provides shelter for waterfowl and fish.

Three-square rush (*Scirpus fluviatilis*). Plant at any time of year on damp soil, and in water up to 12 inches deep. It produces a series of hard, stonelike tubers in the soil which are connected together with a runner or rhizome that when mature is about the size and strength of bailing wire. This network of hard tubers and wirelike runners form a massive root structure that binds the soil together to prevent erosion. It grows 4 to 6 feet tall on a strong three-cornered stem.

Burreed (*Sparganium eurycarpum*). Plant any time of the year in damp soil and in water up to 10 inches deep. It grows approximately three feet high with leaves that resemble cattail. Has an ornamental seed head about golf ball size with diamond-shaped seeds that are eaten to some extent by waterfowl and upland game birds. Its roots are a favorite food of muskrats and the foliage is used by them to build their houses. Do not let the name burreed confuse you because it does not have a bur that sticks to clothing or animal hair. In a small pond plant a couple of burreed with a few arrowhead in the same pot. This makes a pretty ornamental combination.

Cord grass (*Spartina alterniflora, S. pectinata*). Perennials; can be planted at any time of the year. Prefers shallow water in ponds, lakes, streams, or marshy areas subject to flooding, but will survive dry periods. *S. alterniflora* grows best in salt marshes whereas *S. pectinata* is widespread throughout the United States in fresh and salt water. Cord grass is an important soil binder along the water's edge and provides cover and some food for waterfowl and muskrats. Grows 4- to 6-feet-tall and is very attractive with its waving plume or seed head.

Cattail (*Typha latifolia, T. augustifolia*). For best results plant in damp soil or water up to 10 inches deep, although they will grow in deeper water. Rootstocks can be planted at any time of the year. Provide excellent cover for waterfowl, upland game birds, song birds, and other wildlife. The rootstocks are an excellent food for muskrats and its foliage is used for building their houses.

Wild celery (*Vallisneria spiralis*). The same cultural information as above, except that it will not grow in stagnant or small landlocked ponds. It requires fresh moving water, either by flowing water or movement of the water back and forth by the wind.

Wild rice (*Zizania aquatica*). Plant seed in fall or spring in water 6 to 18 inches deep in coves or bays where it is sheltered from strong waves. Wild rice will not grow in stagnant, strongly alkaline, limey, or salt water. Needs movement or changing of water by wind action or a slow-moving stream. Ripe seed can be thrown into the water and it will sink to the bottom. It reseeds each year. Wild rice is an excellent food for waterfowl, and muskrats will eat or cut off the young stalks for food for themselves and their young. This was one of the staple foods for the Indians.

Many of the plants listed will grow in different depths of water or in other soil conditions. I have merely noted those conditions that will give the best results. Also remember, any pond, lake, or wetland should be managed the same as a farm or a garden. Many plants may take over a pond or wetland unless controlled. This is especially true of the non-food-producing plants which are vigorous competitors. ❦

J. Fazio

Webb's Mill Bog, Pine Barrens, N.J.

BOG PLANTS OF THE NORTHEAST

Jacqueline Fazio

The process that transforms open ponds or wet areas into a spongy, seemingly solid mat can take thousands of years to complete. A bog is formed by an accumulation of plant debris on a foundation of intertwining roots from trees and shrubs. As the wet area fills in, the water beneath stagnates and becomes oxygen starved, decomposition slows, and nutrients become scarce. The result is a very acidic environment that suits specific types of plants.

Although bogs are not the most common wetlands in the northeast, they are of special interest to naturalists, offering a unique assortment of flora. Bogs develop in a variety of habitats, from the sandy coastal plains of New Jersey, Long Island, and Cape Cod to the cooler woodlands of northern New England.

Trees

In these colder regions of New England, black spruce (*Picea mariana*) and larch or tamarack (*Larix laricina*) are the predominant conifers initiating bog development. The black spruce is the more invasive of the two trees, sometimes forming pure stands. This spruce is a source for pulpwood and is often logged. The larch, although present in these boglands, does not find this environment as favorable and rarely reaches its maximum height in this habitat. Its range extends further south into northern Connecticut. As cooler weather approaches in New England, larches show their true colors. The needles of these deciduous conifers turn bright orange-yellow, then drop. White cedar (*Chamaecyparis thyoides*) grows in the bogs of southern New England and the coastal plains areas. It forms the purest stands of any North American tree. The wood is light in weight and decay-resistant, and consequently these stands are sometimes decimated by lumbering.

Shrubs

The acid conditions that exist in bogs provide an excellent habitat for shrubs of the Heath Family (*Ericaceae*). They grow on the edges of the bog and sometimes form colonies on the soggy surface. Some of the most commonly found members of this family include leatherleaf (*Chamaedaphne calyculata*), a semievergreen shrub with white flowers which blooms in April/June, and Labrador tea (*Ledum groenlandicum*), a northern bog shrub with dark green leaves with fuzzy brown undersides and white flowers that appear on terminal clusters in May/June. The fragrant leaves of Labrador tea were brewed as a substitute for tea during colonial times. Rhodora (*Rhododendron canadense*) is a low shrub with slightly pubescent leaves. Its azalea-like magenta flowers appear in May before the leaves. Sweet pepperbush (*Clethra alnifolia*) has fragrant white flowers in July/August. Cranberry (*Vaccinium macrocarpon* and *V. oxycoccos*) is a creeping shrub with small leaves. The flowers are pink and appear in June/July. The fruit is a bright red berry maturing in October. It

M. Joyner

A pink-flowering creeping shrub, the bog cranberry (*Vaccinium macrocarpon*) produces edible dark red berries in autumn.

is commercially cultivated for its berries in parts of New Jersey and Cape Cod. Other shrubs of interest include bog-laurel (*Kalmia poliifolia*), sheep-laurel (*K. angustifolia*), bog-rosemary (*Andromeda glaucophylla*), poison sumac (*Rhus vernix*), and sweet gale (*Myrica gale*) which is a member of the Myricaceae Family.

Herbaceous Plants and Ferns

There is an unusual variety of herbaceous plants existing on the bog surface. Sphagnum moss (*Sphagnum* sp.), a bryophyte, grows prolifically in this environment. It forms a soft green covering on the bog. Its ability to absorb water, up to ten times its weight, contributes to keeping the surface of the bog cool and moist. Peat moss is decayed sphagnum moss.

Insectivorous plants also grow in bogs. Plants such as the thread-leaved and round-leaved sundew (*Drosera filiformis* and *D. rotundifolia*) grow here as does the only northern species of pitcher plant (*Sarracenia purpurea*). Bladderwort (*Utricularia* spp.) is a genus of about two hundred species of which approximately five are found in bogs in this area.

M. Joyner

Similar but more elaborate than its northern cousin, below, the southern pitcher plant (*Sarracenia flava*) is hardy throughout Virginia. Its blossom is bright butter yellow.

J. Fazio

The northern pitcher plant (*Sarracenia purpurea*) has purple-tinged flowers and leaves. Some of the leaves are modified to form insect traps. The digested insects add nutrients to the mineral deficient bog soil diet of pitcher plants.

J. Fazio

The well-named showy lady's slipper (*Cypripedium reginae*) is the largest northern orchid. Its pink-tinged white flowers appear in early summer.

Terrestrial orchids have adapted to the nutrient-poor habitat of bogs by forming a symbiotic relationship with mycorrhiza (soil fungi). These mycorrhiza penetrate the roots of the orchids, delivering nutrients from the soil and, it is believed, receiving complex organic compounds in return. The difficulty in getting this fungus established accounts for the problems in transplanting these orchids. The most common orchid genus in southern New England is the fringed orchid (*Habenaria* spp.). Other orchids include rose pogonia (*Pogonia ophioglossoides*), swamp pink (*Arethusa bulbosa*), and grass pink (*Calopogon tuberosus*). All have pink flowers and all bloom from May to August. Showy lady's slipper (*Cypripedium reginae*) and pink lady's slipper (*C. acaule*) are occasionally found in the cooler northern bogs of New England.

There are other assorted herbaceous plants found in bogs. Cotton grass (*Eriophorum virginicum*), a member of the Sedge Family (*Cyperaceae*), forms tussocks on the surface of open bogs. The bog-hyacinth (*Helonias bullata*) and bog-asphodel (*Narthecium americanum*) are both found in the southern part of the northeast, while the bog-bean (*Menyanthes trifoliata*)

M. Joyner

At home in the acid woods of the north, the pink lady's slipper blooms in late spring.

grows in the cooler bogs of the northern northeast.

Mosses and ferns also grow in boggy environments. Fox-tail clubmoss (*Lycopodium alopecuroides*) and Carolina clubmoss (*L. carolinianum*) are found in the southerly coastal plains area. The regal fern (*Osmunda regalis*) and cinnamon fern (*O. cinnamomea*) thrive throughout the boglands of the entire northeast. The rare curly-grass fern (*Schizaea pusilla*) is found only in bogs of southern New Jersey. Its miniature size makes it difficult to find even where it is abundant.

Roche

Covered with silvery hairs, the croziers of cinnamon fern (*Osmunda cinnamomea*) appear in mid-spring. The fertile leaves turn a cinnamon brown as they mature. It flourishes in damp areas.

J. Fazio

Found only in the Pine Barrens, Eastern Long Island, and Canada, the curly-grass fern (*Schizaea pusilla*) is only easily found in winter when its evergreen sterile fronds stand out in the dead grass.

Making Your Own Bog

A bog can be created in a backyard. It requires a fair amount of work, however. Dig an area three feet in depth of a size and shape to suit your garden. Line the inside of the hole with concrete, heavy plastic, or tile. Fill the area as follows:

3 ft.	18″	Sphagnum peat moss
	12″	Builder's sand
	6″	Coarse gravel

It is important that the roots of the plants have constant moisture. The correct soil pH is also crucial for these plants. A pH between 3.5 (very acid) and 5 (moderately acid) is desirable. To increase (sweeten) the pH of the soil add lime; to decrease (acidify) add aluminum sulfate at the appropriate rate. pH test kits and the above supplies should be available at local garden centers with directions on their use. Flood the area several times until the peat moss is soggy and saturated, then check the pH. Once the pH is correct, start planting.

A large number of bog plants are protected by law. If you find a source for these plants, please make certain that they are reliable growers and not collecting plants from the wild. ❦

TROPICAL AND TEMPERATE WATER PLANTS FOR THE HOME AQUARIUM

Michael Ramirez

Growing aquatic and semi-aquatic plants in the home is becoming increasingly popular. A suitable selection of water plants tastefully planted in an aquarium under grow lights with decorative rocks and even driftwood can be very attractive. The beauty of water plants prospering in their aquatic environment presents an appealing picture.

Aquariums can be purchased in many shapes and sizes. A convenient size is a twenty-gallon rectangular tank. Smaller aquariums of 5, 10, and 15 gallons are also available.

Growing Medium

A good planting medium is a mixture of one part (by volume) clay soil to three parts of unwashed fine-textured yellow builder's sand. Moisten the mixture and place on the bottom of the aquarium. The soil mix can be contoured, sloping from the back toward the front. A slope of four to two inches in depth is desirable. The sloping bottom can be held in place by terracing with non-toxic rocks, driftwood, or petrified wood, available at most tropical fish dealers. When using the mixture of clay and sand, top it off with a thin layer of No. 1 aquarium or bird gravel to prevent clouding of the water when the aquarium is being filled.

When the soil mixture is in place cover with a towel or several layers of newspaper. Then fill slowly with tap water to a depth of one-third to one-half of the height of your aquarium. This will facilitate planting without getting wet. Use a water conditioner to remove chlorine or simply allow the water to stand twenty-four hours before planting. When filling your aquarium, condition or age the water in the same manner.

Light

Strong light is essential for the proper growth of aquatic plants. I have used a total of 90 watts of cool-white fluorescent tubes for a 55-gallon aquarium. Incidental natural light from a nearby window with morning sun will contribute the full spectrum of light that the plants need. Experiment with the amount of light necessary for your aquarium. Twelve hours of light daily will keep the tropical water plants growing and, in some instances, prevent water plants from the temperate regions from becoming dormant, or losing their leaves. Newly planted aquariums are susceptible to growth of algae. If the water becomes green or cloudy or a film of algae begins to grow on the plants and rocks, cut down the amount of light.

Accessories

Electric heaters and thermometers are necessary for aquariums containing tropical water plants. The optimum growing temperature is 75–80°F. A lower autumn and winter night temperature of 70° is beneficial.

A combination thermostat-heater of 250 watts is adequate for an aquarium of 50–55 gallons. Consult a tropical fish dealer for the correct wattages for other sizes. An accurate thermometer is also necessary to check the heater's temperature settings.

A cold water or unheated aquarium will depend on room temperature for its heat. In the winter, a night temperature of 50–60° is preferable for plants from the temperate regions.

Filters

A filter serves several purposes. It will filter out small particles of matter and keep the water clear. The water movement will also ensure a uniform temperature throughout the aquarium. A further benefit is the aeration by agitation. A small power filter for aquariums of thirty gallons and up is adequate. For a smaller aquarium, use a small bubble-up inside or outside the filter. The under-gravel filters do not seem to work as well.

Plants for Heated Aquariums

In selecting plants for heated aquariums, the water gardener can choose from three categories; stem or branch plants, single plants with crowns, or floating plants. Stem plants include *Hygrophila* spp., *Rotala* spp., and some *Myriophyllum* spp., all of which are sold in bunches. Remove the lead weights and rubber bands and make fresh cuttings of 6 to 8 inches. Strip off the bottom leaves to expose two or three pairs of nodes and insert the stem into the sand. Plant these tall-growing plants in groups in the back and corners of aquariums.

Crown plants, such as *Echinodorus* spp. and varieties known collectively as sword plants, have both tall- and shorter-growing members. The tall-growing, narrow-leaved sword (*E. amazonicus*) makes a splendid centerpiece, as does the broad-leaved sword (*E. bleheri*). Another suitable candidate for this purpose is the handsome, ruffled, broad-leaved sword (*E. leopoldina*) which has long, undulating leaves. For the front of the aquarium, pygmy chain-sword (*E. tenellus*) is the smallest of the genus and grows in a rosette with runners.

Other plants suitable for use as focal points are the larger species of *Anubias* and *Aponogeton*. *Vallisneria* spp. and varieties are thoroughly aquatic in habit and appearance. They grow rapidly and spread by runners. Confine by cutting back some of the runners. *V. spiralis* and *V. americana* are taller plants suitable for the background and corners of aquarium. There are also smaller varieties with lovely twisted leaves.

Cryptocoryne is a large genus of marsh and aquatic plants. Many can live and prosper permanently under water. A few that are notable are the small *C. willisii*, *C. affinis*, *C. becketii*, *C. haerteliana*, and *C. petchii*. All have colorful leaves in shades of copper, red, and brown tones and can be used for contrast. They spread slowly by underground runners and in time make lovely ground covers. *C. balansae*, *C. bullosa*, and *C. usteriana* are light-loving and have long, wide strap-shaped leaves that are wonderfully crinkled.

Aquatic ferns, such as *Ceratopteris* spp., *Microsorium* spp., and *Bolbitis* spp., are valuable plants to grow in the aquarium. Java fern (*Microsorium*) grows best when its lateral rhizome is attached to a stone or a piece of weighted driftwood. Treat *Bolbitis* spp. in the same way. Plant water fern (*Ceratopteris* spp.) in the same manner as the aquatic plants previously described.

Floating plants include *Salvinia* spp., *Lemna* spp. (duckweed), dwarf water lilies, *Azolla* spp., and some varieties of *Ceratopteris*. They are not suitable for aquariums because they will cast shade on the bottom-growing plants. However, if their spread is restricted by frequent thinning, they will not cause problems.

Plants for Unheated Aquariums

Bunches of plants of *Elodea, Myriophyllum, Ludwigia, Cabomba,* and *Ceratophyllum* can be used. *Aponogeton* species will do very well, since they will require a cooler resting period in the winter months. Among them is *Aponogeton fenestralis*, the famous Madagascar lace plant. Species of *Sagittaria* are also suitable.

The plants described above are not exhaustive; dealers and growers specializing in aquatic plants can suggest many more. Do not use traditional house plants such as *Dracaena, Maranta,* or *Fittonia* which are often sold as aquatics, because they will not survive underwater. Experiment to find out what performs best in your aquarium environment and suits your taste. ✿

Cultivating an indoor marsh . . .

PALUDARIUMS

Joseph S. Levine

A break in the fog reveals a scene of unusual beauty. Water is everywhere; it permeates the soil, hangs in the saturated atmosphere, collects in the centers of epiphytic bromeliads, and glistens in droplets on delicately colored flowers. An Asian newt stalks ponderously along submerged leaves and branches, pausing periodically to catch a breath at the surface of the water. The newt startles a killifish who dashes out of his hiding place in a thicket of aquatic vegetation and dives into a small underwater cave. Around this new refuge, amphibious mosses and ferns make the transition from aquatic to terrestrial life, climbing onto the rocks at the base of a trickling waterfall. Cascading down the rocks along with the water are several species of *Selaginella* and a trailing *Peperomia,* whose adventitious roots stretch toward the duckweed floating on the water surface below.

The preceding passage might be based on a trip to an Old-World rain forest, but it is actually a description of a scene created within the confines of a converted 55-gallon fish tank. Finding an accurate label for this type of miniature environment is significantly more difficult than building one. It is obviously not an aquarium, but the standard term *terrarium* doesn't quite fit either. With so much water around, there is precious little terra firma in evidence. A "swamparium" perhaps? The connotation is less than pleasing. Once again a retreat into Latin saves the day for the horticulturist, as we resurrect the term *paludarium* from its post-Victorian fall from grace. According to *Webster's Seventh Collegiate Dictionary,* the adjective *paludal* refers or relates to marshes or fens, which are in turn defined as "low land covered wholly or partly with water." In their book *Aquarium Plants,* Ratraj and Horeman define paludariums as "containers, usually tanks, in which a marsh-like environment is maintained; tanks suitable for amphibious plants and animals."

The Growth Medium

Experienced indoor botanists may be wondering about the water-saturated environment under discussion. Usually the first—the most important—lesson learned by beginning gardeners is to take extreme caution not to overwater plants in containers that lack drainage holes. If heavy soil remains saturated for long, water replaces air in the interstices of the medium. If the situation is not remedied, bacterial activity adds toxic metabolic by-products to the soil and the pH drops precipitously. When soil "goes sour" in this fashion, further root growth is inhibited—even in species that don't mind wet feet—and the plants usually die.

Proper selection of a planting medium helps avoid problems of this type in the paludarium. A soilless mixture composed of two parts sphagnum peat moss, one part vermiculite, one part coarse perlite, one part aquarium-grade activated charcoal, and one tablespoon of ground limestone per gallon of mix is just right for closed-container planting. The major components of the medium give it a light and airy texture, while the charcoal and limestone keep the pH within tolerable limits for long periods of time. The use of sterilized components minimizes the introduction of pathogenic soil microorganisms and insects, while the absence of nutrients for plant growth allows the grower a greater degree of control over plant growth. If rampant growth is desired, the mix can

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be moistened with a dilute balanced fertilizer solution at planting time. Alternatively, slow-release fertilizer pellets can be added to the medium. Local variations in the nature of the planting medium can be arranged to suit the needs of particular plants. Pockets of pure, live sphagnum moss provide the proper conditions for many carnivorous plants, which strongly resent the addition of any chemical fertilizer in the vicinity of their roots. Large flat rocks and fungicide-soaked pieces of tree bark can be used to create raised areas for species that prefer slightly less waterlogged conditions.

Light

Once the medium has been selected, the grower must provide sufficient light to ensure proper plant growth. Low light levels in terrariums are the usual cause of weak, leggy growth, even in ostensibly shade-loving species.

If your paludarium is to be left uncovered, it can be placed near a window to utilize available sunlight. The high humidity required by a number of exotic paludarium species, however, necessitates that tight-fitting covers be employed to maintain a saturated atmosphere. Closed containers of this type should never be placed in direct sunlight, as the resultant rapid overheating will quickly cook the contents. The best solution to the lighting problem in such cases is the provision of 14 to 16 hours of fluorescent light daily. A minimum of two fluorescent tubes the length of the chosen container is recommended. A paludarium in a 10- or 15-gallon fish tank can get by on two 15- or 20-watt bulbs, but a 55-gallon aquarium should be provided with at least a pair of 40-watt tubes. When choosing containers to be illuminated in this manner, keep in mind that light intensity drops off roughly as the square of the distance between the bulbs and the leaves of the plants. Long, low containers generally allow better illumination than short, high ones.

Planning

The actual planning and planting of a paludarium can be as simple or as elaborate as you desire. The design of your personal paludarium is limited only by your imagination and ingenuity. The instructions and suggestions that follow are meant only as guidelines to spark your own creativity.

A primary consideration in your design, of course, is the relative area you wish to devote to dry land and water spaces within your container. I generally disavow any bias and split up the terrain roughly 50-50, although never in a symmetrical manner. The actual division between land and water spaces is made with pieces of one-eighth-inch-thick glass cut into strips several inches wide (the exact width depending on the desired depth of the water area) and varying lengths. These strips are laid out end to end in any pleasing nonsymmetrical path across the bottom of the tank, separating an aquatic area in the front from a terrestrial one in the rear. Once the desired position of the strips has been determined, they are glued into position on the bottom and sealed to each other and to the sides of the tank using clear plastic aquarium sealant. The sealant must be allowed to cure for a full 24 hours, after which the aquatic area should be filled with water to test all internal seams for leaks. If tropical aquatic plants and animals are part of your master plan—as well they should be—you will need to install a submersible thermostatically controlled water heater in the aquatic section. Estimate the amount of water held in the aquatic compartment, and, allowing 5 watts per gallon, purchase the appropriate size heater. For such shallow-water setups, the completely submersible type of heaters are best; these are positioned horizontally and can be hidden behind aquatic vegetation.

Now is the time to consider the incorporation of a waterfall into your design. Whether you choose to create a gently trickling mountain spring or a rushing cataract, the charm of moving water will add an entirely unexpected dimension to your ecosystem in miniature. The type of pump you choose to lift the water will depend upon the amount of water you want it to move; miniature submersible pumps are available from water-garden companies. Once you have the chosen pump in hand, hook it up in a sink or bathtub to get a firsthand idea of the volume of water it will pump to the height you desire through the tubing size you wish to use. With a clear mental picture of this flow in mind, you are ready to design the waterfall itself.

In my paludarium the waterfall is of the striking type and is situated completely in the aquatic compartment. Thus, the submersible pump is simply hidden in a bunch of underwater moss, and a tube is run to the top of a carefully arranged group of rocks from where the water is allowed to drip and splash freely into the "river" below. With this design, I simply arranged the rocks as I liked and glued them together with clear plastic aquarium sealer. Wherever I wanted water to flow along an area where two rocks met, I merely sealed the seam between them with cement and, where necessary, glued a few pebbles along the way to hide any artificial-looking gaps. If you prefer a waterfall that falls across the entire length of your terrestrial area before it reaches the bottom, you can construct a channel for it out of instant cement mix. In either case, time and care should be taken to arrange rocks and other natural objects to eliminate all hints of artifice. Naturally, a little advance planning will help you in this regard. Leisurely summer strolls along beaches and through woods provided me with assorted river stones, gravel, and unusual pieces of driftwood and bark, all of which were stored away to be sorted over at paludarium planting time. Most natural objects of this type quickly become substrates for mosses and creeping ferns in paludariums, making the scene look unexpectedly realistic.

Once either the waterfall or other landscaped centerpiece has been arranged, it is time to collect the plants and get to work on the horticultural part of the endeavor.

Suitable Plants

What kind of plant species can be utilized in this kind of artificial environment? Depending on your preferences and skill, you can include a number of unusual species that will thrive in a very wet environment.

Aquatic mosses and ferns are perfect paludarium specimens. If they are obtained in their aquatic growth forms and placed underwater, they will grow submerged for indeterminate periods of time and then suddenly begin to climb out onto wet rocks or damp pieces of wood. In the process, their appearance will change.

Species of *Vesicularia,* or Java moss, and *Marsilea,* or water clover—which is actually a fern and not a clover at all—are particularly attractive. Other ferns that produce larger fronds can also make a water-to-air transition in a humid paludarium, but instead of creeping out, they suddenly throw out aerial fronds from just beneath the water's surface. Java ferns (*Polypodium pteropus*) produce aerial fronds that differ little in appearance from their submerged ones, but the water sprites (*Ceratopteris* spp.) give rise to above-water fronds bearing little or no resemblance to the aquatic form.

Many other plants commonly cultivated in aquariums will reveal their true amphibious dispositions if given the opportunity to grow in a paludarium. Species of *Rotala, Ludwigia, Alternanthera,* and many other so-called bunch plants sold in pet stores can be placed underwater and allowed to continue tip growth out into the air, where they will often flower. Many of the various Amazon swordplants (*Echinodorus* spp.) will grow contentedly as aquatics in shallow water for a time, and then suddenly begin to produce first floating and then emergent leaves. The genus *Cryptocoryne* contains many beautiful small-growing species that are generally rather difficult to cultivate totally submerged. If planted with their roots in soggy soil and their leaves in the saturated atmosphere of the paludarium, however, they grow remarkably well, often flowering and reproducing vegetatively the same time.

An earlier HORTICULTURE article on aquarium plants (June 1979) described species native to amphibious habitats along tropical rivers. Because of widely fluctuating water levels in these areas, the native plants have been forced to adapt themselves to alternate submersion and emersion on a seasonal basis. Although they need to function underwater for long periods of time, these plants are prevented from becoming totally aquatic by periodic exposure to air. In fact, since most of their time is spent in a condition midway between total submersion and total emersion, the majority of these species grow and flower best with their leaves in air and their roots in waterlogged soil. These are paludarium plants par excellence.

Straddling the air-water interface are assorted species of *Selaginella*—a paludarium keeper's delight. Resembling a cross between a large moss and a small fern, *Selaginella* species revel in the wet, warm, humid paludarium environment, growing densely and attractively if provided with good fluorescent light. If placed at a land-water junction, they will grow in both directions, sending runners along the surface of the soil and for long distances underwater. They are ideal for growing over rocks and bark and will eventually hide your waterfall if you are not ruthless in trimming them back. Several *Selaginella* species are peculiarly slow about becoming established in a new environment; they occasionally take several weeks to settle in. Once they have established themselves, though, stand back! *Selaginella kraussiana* is the most commonly encountered species, with two attractive cultivars: the yellow-tipped *S. kraussiana* 'Aurea' and the dwarf, emerald-green *S. kraussiana* 'Brownii'. Other species are usually available only from mail-order plant specialists but are certainly worth hunting for. Forms and colors vary from the creeping, iridescent blue-green *S. uncinata* to the upright, arborescent, white-variegated *S. martensii* forma *albolineata,* and the spreading, fan-like *S. pallescens.*

Houseplant Prospects

Several familiar houseplants can also serve as temporary members of small paludariums or permanent parts of larger ones. Horticultural varieties of Chinese evergreen (*Aglaonema modestum*) and seedling palms like *Chamaedorea elegans* are good examples of old favorites with hidden amphibious sides to their personalities. Both grow well with wet feet, and their height and leaf structures make them valuable as "trees" in your miniature landscape. The only problem is that both of these plants will probably grow so well in the paludarium that they will outgrow their allotted space in a year or so. Palms will have to be removed at this time, but *Aglaonema* species can simply be cut back and the tip cuttings planted.

Moving just above the waterline, we come to the preferred microhabitat of a number of exquisite flowering and foliage plants belonging to the Gesneriaceae Family. Members of the genus *Gesneria* are especially suitable for paludarium culture. They remain relatively compact, flower extremely well under fluorescent lights, and like to be kept constantly moist. Both *G. cuneifolia,* with its narrow green leaves and tubular, firecracker-red flowers, and *G. humilis,* with its smaller habit and bright yellow flowers, add splashes of color to the scene with their periodic blooms.

Although carnivorous plants are ideal subjects for wet, humid places, most of them require prodigious amounts of light in order to grow compactly and acquire their full color. If your paludarium is of a long, low configuration, you can experiment with several species of *Drosera* (sundews), *Utricularia* (bladderworts), and, of course, the famous *Dionaea,* the Venus-flytrap. These carnivores prefer pockets of live sphagnum and as intense a dosage of fluorescent light as you can arrange to give them. Somewhat less demanding in light requirements and equally fascinating in appearance are several of the smaller species of *Nepenthes,* exotic tropical pitcher plants that are semiepiphytic but must never be allowed to dry out.

Several rare and extremely beautiful begonias like *Begonia versicolor* and its hybrids, as well as the rare *Symbegonia* species from Australia, add colorful foliage to the scene. Keep your eyes open in the not-too-distant future for the true miniature rex begonias currently being hybridized. Today's rex begonias all grow far too large for paludarium culture, but these true miniatures—with full-grown leaves no larger than a quarter—will surely take the country by storm when they are released in a few years. Other difficult-to-find gems include a few tiny *Calathea* species like *Calathea micans* and *C. undulata* and a few truly miniature ferns. Beware of most "dwarf" ferns and begonias that are widely available; while normally diminutive, they will usually triple their size under the ideal conditions of a paludarium.

GEORGE H. PRING—WATER LILY HYBRIDIST

Deni Seibert (Isabelle Pring)

Growing up with a father who was the world's expert on tropical lilies made life a carousel of enchantment. George Harry Ethelbert Pring (he took a lot of ribbing for that third moniker), "Pop" to me, loved people and plants in that order and they loved him. Whether bowling for the St. Louis Cricket Club or judging a flower show, he did it with dash and humor.

He was born in 1885 in Exmouth, Devonshire, England and during early childhood moved with his family to Twickenham where he received his schooling. "When a young lad," he would tell me, "I helped clean flower pots at the famous Kew Gardens, walking a long distance each day to earn a few pence." Picture my surprise when as a teenager he first took me to see his English home and I found that "long" walk was just across a small green.

"Guess my legs were shorter then," he laughed.

Washing pots led to a romance with horticulture. "I wanted to be a student in the Queen's School of the Royal Botanic Garden at Kew, but they required one to be twenty-one years of age. So I decided to prepare myself by surreptitiously taking their written exams in physics, chemistry, etc., for practice. Boy, was I scared one day when the director called me into his office. I thought he would bounce me, instead he told me I'd done so well they had decided to set aside the age requirement for me."

"Young George" as he was called became the youngest student to train at Kew and when he graduated at twenty, the director offered him a job in Calcutta or St. Louis. "I think you'd make a better American with your brashness than an Indian," he was told.

A Career Blossoms

In 1906, when he arrived in St. Louis to be the foreman in charge of orchids and exotic plants at the Missouri Botanical Garden, he was asked what he thought of their orchid collection. "Well," he responded, "you haven't much of one have you?"

On a boat trip to England, he met stunning Belle McAdie from Long Island. They married in 1910 and raised a family of four, George, Charles, Bradford (all of whom became horticulturists), and me (I married a botanist). Pop's wonderful world of flowers enfolded all of us.

He proceeded to build the three hundred orchid plants he found at Missouri into a world-famous collection of over fifty thousand specimens. To accomplish this, he went on numerous collecting trips to the jungles of Colombia and Panama.

Pop's contacts and foresight stimulated the establishment of MBG's tropical station in the Canal Zone for research in orchids and tropical plants. He became a charter member, trustee, and vice-president of the American Orchid Society, and organized as General Chairman the 1st World Orchid Conference, held in St. Louis in 1954.

Enter Water Lilies

Although he began his career as an orchid specialist, in 1912 his attention turned to breeding water lilies as well, "because I can see the results in a year rather than seven with orchids." Tropical water lilies became his great passion.

He introduced the day-blooming Whitaker Strain from Africa, for which he received the National Gardeners Association

Courtesy of Slocum Water Gardens

The day-blooming tropical water lily, 'Mrs. George Pring', hybridized by her husband. It is a pure white with speckled foliage, blooming in late summer.

Gold Medal in 1920. His all-time favorite, which he hybridized in 1922 and named 'Mrs. George H. Pring', was the first white hybrid day-blooming water lily. Other hybrids including the pink 'General Pershing' brought more awards in 1922 and 1923. One of his greatest introductions was the Lost Yellow Lily from Africa. He crossed it with 'Mrs. George H. Pring' and brought forth the famed 'St. Louis' in 1932, the first water lily of Garden creation granted a U.S. patent.

Walking home from elementary school each day through the Garden (we lived on the property), I often found Pop in hip boots, bent over in the middle of a lily pool pollinating the water lilies. "I'm going to name one for you someday," he told me, and 'Isabelle Pring', a viviparous white was the result. Imagine the thrill for a youngster to be so immortalized. Later, he produced a yellow one, 'Aviator Pring', named for my brother, Bradford, who had been killed in an army aircrash. Home gardeners rejoiced when he developed a pygmy water lily tiny enough to grow in a barrel. This he called 'Joanne Pring' after his first granddaughter.

He was appointed superintendent at MBG in 1928 and remained there until

1969—sixty-three years of joyous, devoted service. St. Louis knew him as "Mr. Answer Man" for he was never stumped with any question on plants. Over eight thousand requests a year came to his office and he was the first to respond to poison plant emergencies.

His last accomplishment of note in the field of water lilies was designing the magnificent lily pools at Longwood Gardens, Kennett Square, Pennsylvania. He spent his declining years there with my husband, Russell J. Seibert, and me. Although his eyesight failed, Pop recognized every plant by touch when taken through the conservatory. That was the mark of a true plant lover. ❦

SOURCES

There is now a new plant society devoted to sharing information on aquatic plants. Individuals interesting in joining should write to the Water-Lily Society, P.O. Box 104, Lilypons, Maryland 21717.

Kester's Wild Game Food Nurseries, Inc.
P.O. Box U
Omro, Wisconsin 54963

Lilypons Water Gardens
1500 Amhort Road
P.O. Box 10
Lilypons, Maryland 21717-0010

Paradise Gardens
16 May Street
Whitman, Massachusetts 02382

Scherer and Sons
104 Waterside Avenue
Northport, New York 11768

Slocum Water Gardens
1101 Cypress Garden Road
Winter Haven, Florida 33880

Superior Tropical Trading Co.
121 West Avenue
Hicksville, New York 11801

William Tricker, Inc.
74 Allendale Avenue
P.O. Box 398
Saddle River, N.J. 07458

Van Ness Water Gardens
2460 North Euclid Avenue
Upland, California 91786

FURTHER READING

A Guide to Water Gardening by Philip Swindells. Scribners, New York. 1975

A Manual of Aquatic Plants by Norman C. Fassett, University of Wisconsin Press, Madison. 1957

Aquatic Vascular Plants of New England: Part 1–7, by C.B. Hellquist and G.E. Crow. New Hampshire Agricultural Experiment Station, University of New Hampshire, Durham, New Hampshire.

Common Marsh, Underwater and Floating-leaved Plants of the U.S. & Canada by Neil Hotchkiss. Dover Publications, Inc., N.Y.

Earth Ponds—The Country Pond Maker's Guide by Tim Matson. Countryman Press, Woodstock, Vermont.

How to Know the Aquatic Plants by G.W. Prescott. Wm. C. Brown Company Publishers, Dubuque, Iowa. 1969

Rock and Water Gardens by Editors of Time-Life, Time-Life Publishers, Alexandria, Va.

The Complete Guide to Water Plants by Helmut Mühlberg, Sterling Publishing Co., Inc., N.Y.

The Damp Garden by Beth Chatto. Biblio Distribution Center, Totowa, N.J.

The Water Garden by Frances Perry. Van Nostrand Reinhold, New York.

Water Gardener's Handbook by Philip Swindells. The Overlook Press. N.Y.

Water Gardens by Gordon T. Ledbetter. Interbook Inc., San Leandro, California.

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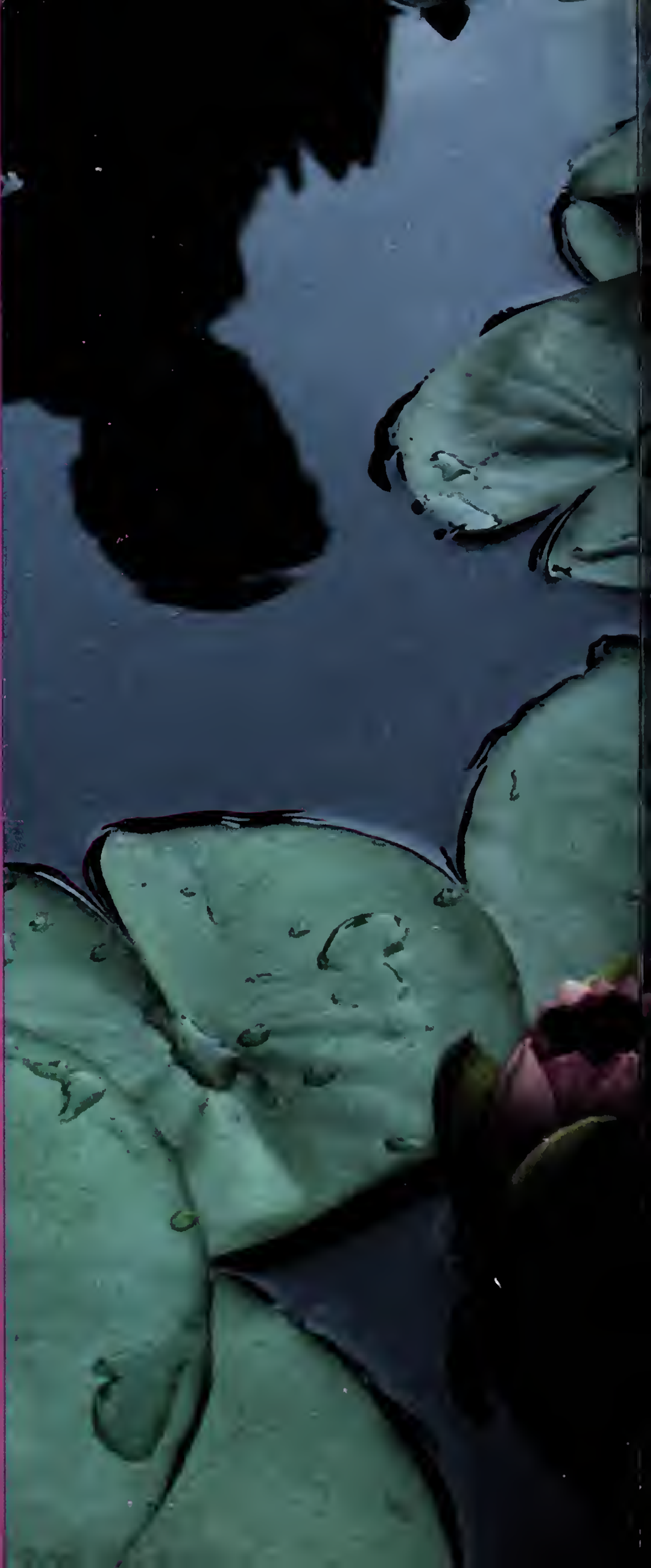
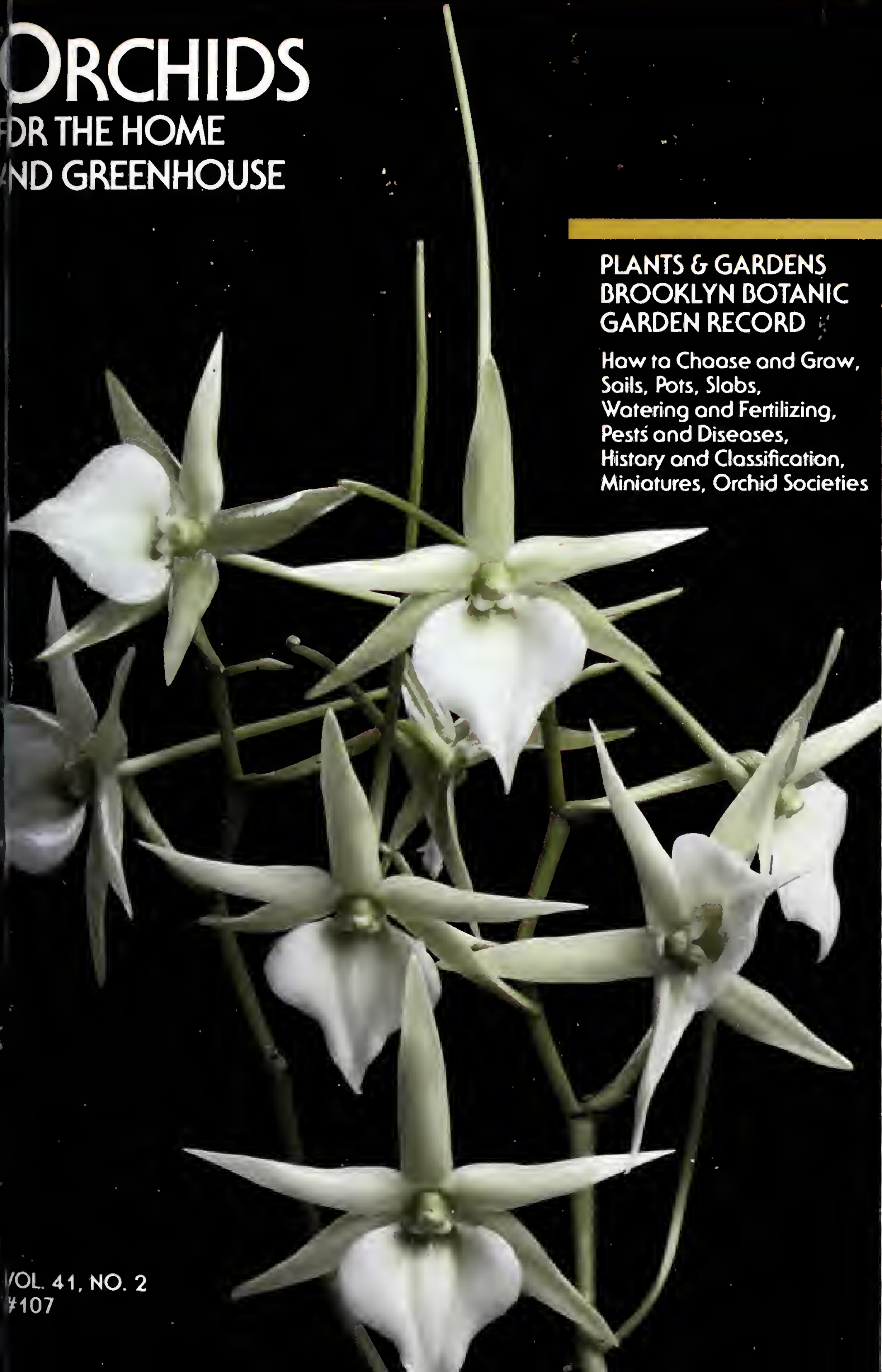


ORCHIDS
FOR THE HOME AND GREENHOUSE

PLANTS & GARDENS
BROOKLYN BOTANIC
GARDEN RECORD

How to Choose and Grow,
Soils, Pots, Slabs,
Watering and Fertilizing,
Pests and Diseases,
History and Classification,
Miniatures, Orchid Societies



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Brooklyn Botanic Garden

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PLANTS & GARDENS

BROOKLYN BOTANIC GARDEN RECORD

ORCHIDS
For the Home and Greenhouse

Vol. 41 Summer 1985 No. 2

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ARNOLD (ARNIE) LINSMAN has grown orchids in his Manhattan apartment for almost ten years; president of the Greater New York Orchid Society and a director of the Eastern Orchid Congress. Also general chairman of the Greater New York Orchid Show.

NED NASH, vice president of Armacost & Royston, orchid growers in Carpinteria, California; trustee of the American Orchid Society; judge for the Cymbidium Society of America and probationary judge for the American Orchid Society.

MICHAEL S. OWEN, Longwood Gardens, Kennett Square, Philadelphia. With Larry Clouser, he maintains the orchid collection which contains approximately six thousand plants in six greenhouses, including a display area where up to 450 orchids are used at any one time.

CARL L. WITHNER, Ph.D., orchid grower and retired Professor of Biology from Brooklyn College, has traveled, lectured, and judged throughout the orchid world and has written articles for various magazines and books.

LETTER FROM THE BROOKLYN BOTANIC GARDEN

Orchids evoke extraordinary imagery—steamy jungles, vapor-shrouded mountain slopes, tropical rain forests. Their exotic shapes, scents, colors, and textures seem unnatural, yet man is incapable of duplicating them. The fantastic array of flower forms, plant conformations, and habitats boggle the mind.

Most of us first glimpsed an orchid on the shoulder of mother or grandmother on some very special occasion. Cattleyas, the corsage orchids, have been hybridized for rounded form and clearer color just for this purpose. For many this may be the only familiar orchid.

The craze for collecting and growing orchids began in England in the late 1800s. It was the titled and monied who could afford to send expeditions around the world to collect orchid plants and have them shipped back to England—and many plants perished because so little was known about their culture. But some did survive and thrive and were cultivated and hybridized in hothouses. It was not until after World War II that orchid growing hit this country.

Darwin used orchids to illustrate his theory for *On the Origin of Species,* published in 1859; three years later he published *On Various Contrivances by which Orchids are Fertilized by Insects, and on the Good Effects of Intercrossing.*

A great deal of what we know today of the unique mechanisms which make most orchids reproductively isolated is still attributable to Darwin. There are fascinating relationships between orchid flowers and their pollinators and the adaptations that have been made by both, all of which makes the lure of orchid growing even more fascinating.

It has been a joy to work with Charles Marden Fitch, Guest Editor of this Handbook. He made time in his busy professional life to gather a world-renowned group of experts as contributors to share their expertise with you within these pages. You will find a wealth of extraordinary orchid photographs, many taken by Mr. Fitch, that are bound to whet your appetite for new purchases. Our special thanks to Mr. Fitch and to all of our contributors.

Whether a beginning orchid grower, or one who wishes to add to accumulated knowledge, we wish you happy reading and good growing.

Barbara B. Pesch
Editor

WHAT IS AN ORCHID?

Carl L. Withner

How many times have people asked me if an iris isn't some kind of orchid? No. Orchids are not lilies, amaryllids, gingers, cannas, bananas or irises, but all are closely related. These families are grouped together to form the monocots of the botanical world, and the orchids are noteworthy for having the most specialized flowers, habits and life histories in the entire group.

Flower Characteristics

The major distinction of the orchid flower is the *column,* the single reproductive structure formed by a fusion of stamens and pistils that are separate in the flowers of the other families mentioned above. Though there are basically three stamens and three pistils, usually only the anther of one stamen remains functional, bearing its pollen at the tip of the column. The stigmatic surface, the part of the column that receives the pollen, is just below it.

The orchid flower has three sepals, alternating with three petals. The sepals protect the flower in the bud, but become colored and petal-like when the flower opens, often giving the impression of a six-petaled flower, or five petals plus one that is different. The different petal (and one always is) is called the *lip.* The lip petal is marked by unusual form, veining patterns and usually a series of keels and protuberances called a *callus.* The shape of the lip and its callus—sometimes the whole flower—is highly adapted for insect attraction with resulting pollination. In fact, the evolution of the orchid family closely parallels the evolution of pollinating insects.

Fruits and Seeds

If pollination takes place, a seed pod forms that may require as long as 14 months to develop. Usually about nine months will suffice, and the pod may have literally millions of seeds in it. The seeds are almost dust-like in size and are easily carried by wind and water for great distances. The embryo of the orchid seed is so tiny and underdeveloped, in comparison with other types of seed, that special conditions are necessary for its germination and growth (see the article by Joseph Arditti). Until the little ball of undifferentiated cells becomes green, forms a growing point and finally begins to develop tiny leaves, it must live in symbiotic association with a favorable fungus. It is not surprising that from the many seeds produced in a single pod only a few survive to grow to adulthood—a process that may occur in a few months but with most species takes from six to twelve years.

Orchid Evolution

Orchids most likely originated in the warm regions of southeastern Asia and spread from there throughout the world. While the majority remained in the tropics, others, in migrating, became adapted to colder climates by means of seasonal growth that responds to changes in temperature. In the tropics, some orchids can grow more or less continuously, but most are seasonal there, too, responding not to winter *vs.* summer, but to the effects of alternating wet and dry periods. Such factors must be considered in the culture of these plants.

Growth Patterns

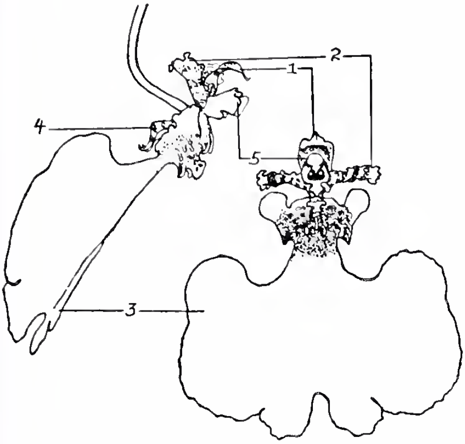
The orchid plant itself has a variety of forms that merge into three basic patterns, one terrestrial, the other two epiphytic (*epi* = upon; *phyton* = plant). Terrestrial orchids in both tropical and temperate zones form leaves and flower stalks from underground corms and rhizomes that enable the plant to winter over. In fact, the name orchid is from the Greek *orchis,*

DIVERSITY IN DESIGN

Some examples of orchid flowers of distinctive form

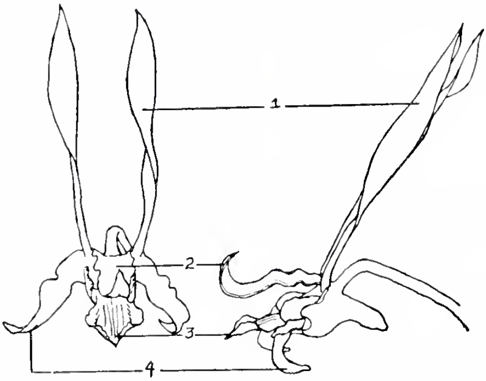
Key to the drawings: 1—dorsal sepal; 2—petal; 3—lip; 4—lateral sepals; 5—column.

Drawings by Sydney Kenna



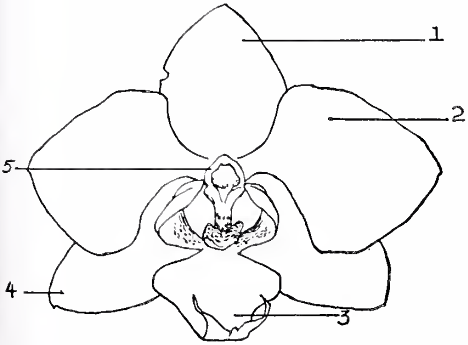
Oncidium Java

Note the heavy callus (the dotted portion, indicating tubercles) on the lip; also the tremendous size of the lip in relation to the rest of the flower.



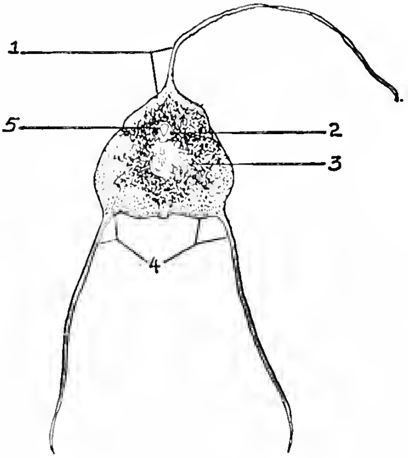
Dendrobium d'albertisii

Here the column is hidden. Petals are elongated. Keels replace the usual tubercles of the callus on the lip. The two lateral sepals form a spur at the base.



Phalaenopsis

In this typical hybrid, the lip is markedly three-lobed, with two short threadlike tips on the mid-lobe. Sepals and petals are similar in size.



Masdevallia erythrochaete

Note that the combined sepals form a broad-mouthed tube with three long tails. Petals and lip are in the center, greatly reduced in their dimensions.

meaning testis, in reference to the appearance of these underground parts. Theophrastus, Dioscorides, and other ancients of Europe and Asia Minor were the first to describe such orchids. In those days people were interested in the presumed medicinal uses of plants and whether or not they had souls, and thought that the shape or structure of a plant "told" what it was good for.

In the tropics, the habit of most orchids is to perch on the branches of trees, or sometimes rocks, from which they derive support but nothing else—they are *not* parasites. If the orchid grows constantly from the tip, and propagates itself by forming offshoots (known as "keikis" from their Hawaiian name) from the base of the plant, we refer to the growth pattern as *monopodial* (single-footed). Monopodial orchids are found especially in the forests of southeastern Asia, the Philippines, Madagascar (Malagasy) and Africa. If the plants grow seasonally, responding to wet and dry periods, sending up a new branch each season from the main rhizome, they are considered *sympodial* (with feet). Such orchids are found especially in the New World, but also where the monopodial types grow.

Learning to grow orchids in cultivation and to recognize the different sorts are among the intellectual challenges constantly presented by these plants. No other family involves so many aspects of horticultural activity, from laboratory to greenhouse or garden. No other family can present some 30,000 species and some 75,000 hybrids for the grower to choose from. To anyone who becomes attached to them, orchids soon become much more than botanical curiosities—they are likely to become a way of life.

Peter K. Nelson

Chinese scroll with orchid and bamboo painted at the base and a separate clump of orchids at the top. The "upright" is a representation of a rock. Translation: "Painted after [the style of an 18th Century] artist Chêng." From the scroll collection of Carl L. Withner. Interpretation by Mr. Fong Chow, Metropolitan Museum of Art.

Ernest Hetherington

How the mystique developed . . . .

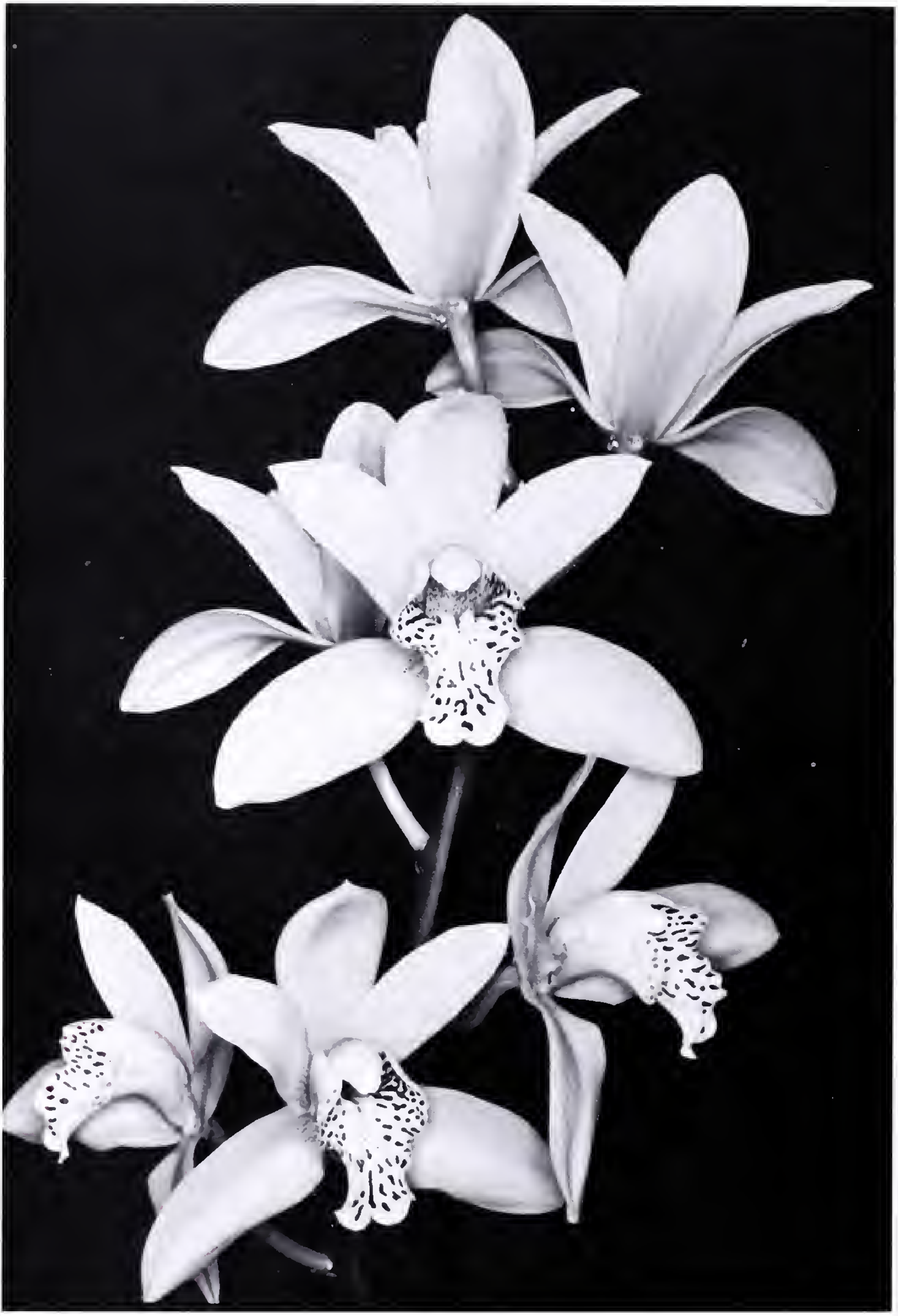
A HISTORY OF GROWING TROPICAL ORCHIDS

Ernest Hetherington

There is reason for us to be surprised and, of course, delighted to read an account on orchid growing by a housewife and mother of five young children living right in the heart of New York City. What is surprising is that Mrs. J. Norman Henry wrote of her experience in "Garden Magazine" of New York in July 1924—over sixty years ago! She must have been a remarkable woman. Everyone told her that the small six by seven foot greenhouse she built would not work. However, Mrs. Henry read up on the subject of orchid growing and *was* successful.

I quote, "A little greenhouse does not necessarily absorb much time, a few minutes several times a day and an hour or two several times a year at potting time, is all that it requires. It means also to me

Cattleya labiata, when introduced to England in 1818, startled the world of horticulture and sparked a fever for more orchids of this type.



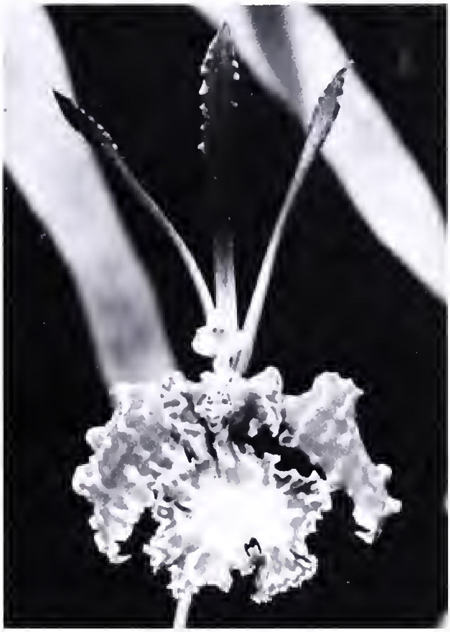
Cymbidium Tiger Tail, a miniature bred at Stewart Orchids, has yellow flowers with a white lip spotted red. Cymbidiums are easily grown in many areas of the world and are the most popular cut-flower orchids in numerous countries.

Phalaenopsis, originally from tropical Southeast Asia, are very satisfactory for home growing because the plants are adaptable and the flowers long lasting. This is *Phalaenopsis* Marion Fowler, a modern hybrid of *Phal. gigantea* with *Phal.* Zada. The flowers are pink, foliage mottled with gray.

that my greatest pleasure is right at my door ready to enjoy at any hour of the day I have a little extra time to spare. That is a great deal, for I have five young children and could ill-afford a luxury that kept me away from them." We further quote Mrs. Henry who said she had been raising orchids for some years prior to her article in 1924, "These first orchids of mine seemed the most beautiful things I had ever seen, and all had the typical fragrance."

It is interesting to note that as far back as five hundred years before the birth of Christ, the Chinese raised certain miniature cymbidiums especially for their fragrance. We shall not go into the history of orchid raising in China. It was really in England and Europe that the marvelous assortment of orchid species such as we know today were first introduced and grown. Vanilla, which is an orchid, was first discovered by Cortez in 1519 during his conquest of Mexico. Plants of vanilla were not cultivated in England, however, until 1739 when some cuttings were sent to England from Mexico by Robert Miller.

The building of the foundation for this modern era extends back well over one hundred years. While there were a number of growers in these early years, they never have come close to the number of growers we have today. Still, it was a different era and the enthusiasm for orchid growing among the wealthy was no less than the beginner with stars in his or her eyes today. Until World War II, England was the homeland of orchid growing in the sense that we know it today. During the devastating years of the war, however, growing orchids commercially in England and Europe was difficult, if not impossible. In Europe, many of the greenhouses were destroyed by bombing. Fuel was difficult to obtain and even if obtainable, the governments decreed that vegetables should be raised in the greenhouses for the war effort rather than orchids. For this reason, during these years many of the finest orchid collections were sent to America and



Ernest Hetherington

Oncidium kramerianum is similar to *Onc. papilio,* the orchid that charmed Lord Cavendish into starting the world's finest collection at the time. Lord Cavendish's orchid fever made orchid growing fashionable.

with them came the interest in orchid growing and the development of America as the center of world orchid growing as we know it today.

We make these comments to gain perspective, for now we must go back to England and Europe and tell a few stories of how orchid growing was developed in these countries. About 1812, some plants of vandas, aerides, and dendrobiums were sent to England from India. At that time, England was the predominant world power and had contacts in all the countries of the world, especially the tropical countries. In 1810, a company known as Conrad Loddiges and Sons began cultivating orchid plants at their nursery in Hackney, England, signaling the beginning of commercial orchid cultivation in that country. Thousands of species were to be introduced and often killed in the greenhouses of England in the years to follow. We say "killed," for as these rare, beautiful, and exotic tropical plants were introduced in their greenhouses, the owners had to learn how to grow them. There was much trial and error and experimentation.

A Sensational Cattleya

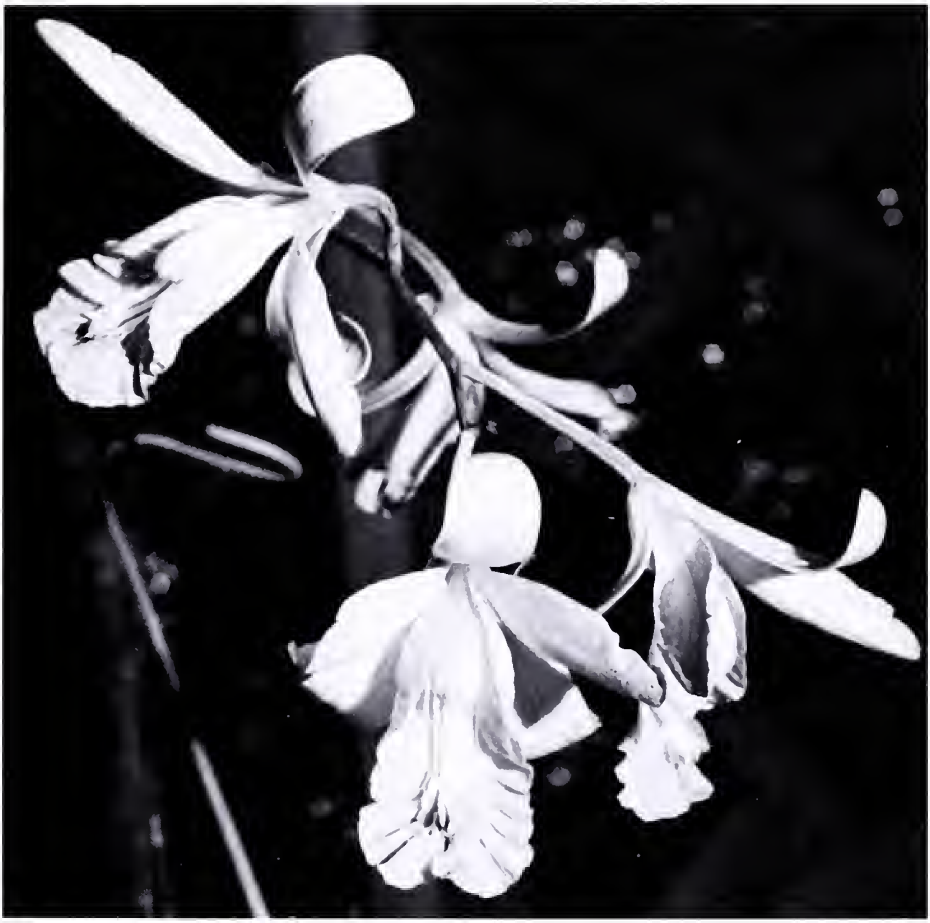
The first blooming of one remarkable new orchid, *Cattleya labiata,* was the most significant event that occurred in the early days of orchid collecting because it developed orchid enthusiasm. This species is a large-flowered purple orchid with a darker purple lip; we all know it today as the purple cattleya. The flowering, we shall call it the "event," occurred in 1818. The plants had been sent to England as packing material by a botanical collector in Brazil. He did not know what they were, neither did those who received the plants in England. William Cattley, of Barnet, England, received some of these strange looking plants with straplike leaves, potted them up and found that they were growing for him. They flowered and the orchid world was never to be the same.

Cattley showed these blooming plants and they were recognized as something new and beautiful in the orchid world. Dr. John Lindley recognized the plants as a new type of orchid and, indeed, a new genus. He described it in the botanical journals and named it Cattleya in Mr. Cattley's honor. Because the purple flower had a large modified petal, which we call a lip, he gave it the name *Cattleya labiata* or the cattleya with the large lip. More plants of this beautiful orchid were sought but they were not discovered in their native habitat for many years. While searching, however, the botanical collectors discovered many other types of cattleyas similar to C. *labiata.* Some of these were C. *mossiae,* C. *mendelii,* C. *trianaei,* and others. In time, various general nurserymen discovered the beauty of orchids and in particular the flamboyant cattleyas. They decided to establish orchid departments and engage in hybridizing or intercrossing these various exotic and beautiful new orchids that were quickly gaining popularity.

A Duke's Collection

During these early years, orchids were surely not everyman's plant. Through the expanding collection of tropical plants of the Royal Horticulture Society, orchids became more popular and were cultivated by the wealthy. If we search for the spark, the real credit for the enthusiasm for growing orchids in England must be given to the sixth Duke of Devonshire, William Spencer Cavendish. He made the growing of orchids as a hobby fashionable. Cavendish saw a plant of *Oncidium papilio* on display at one of the horticultural exhibitions in 1833 and was delighted with the remarkable character and singular charm of this species. The Duke began a collection of orchids at Chatsworth and one of his acquisitions was a white Philippine phalaenopsis which he purchased for 100 guineas, which by today's standards, conceivably could be worth $1,000 or more.

The Duke constantly expanded his collection and sent explorers to the jungles of the world to collect orchids for him. Within ten years, he had the largest private collection of orchids in existence. For many years, as the interest in orchids and the demand for them increased in England, the only plants available were species imported from the jungles of the tropics. As the interest developed also, a number of commercial orchid firms were established in England and Europe which were to be-



Terrestrial orchid *Bletia patula* from Cuba, Hispaniola, and Puerto Rico was one of the first orchids from the New World to be grown in early European collections.

come famous. Some of the most exciting stories about orchids were to be told by the early plant explorers who risked their lives going into the mountains and jungles of the tropics both in the New World and the Asiatic countries to bring something new and beautiful to the greenhouses of England. They were professional orchid hunters in the main, employed by the various orchid nurseries. Some had orchids named after them in time such as Parish, Hartweg, Wallis, and Bateman.

The mania for orchid plants in England caused prices of all available new plants to climb rapidly during these years. Auctions were held in Liverpool and London for which $200 was not unusual for a single plant. Some of the rarest specimens, which had been brought in for the auction from the jungles, commanded prices as high as $3,500 to $5,000 at today's values. Famous hobbyists, desiring their names to be perpetuated in botanical nomenclature, bid freely against one another in the hopes of introducing, through their purchase, new species that might be endowed with the new owner's name. It should be added that in the days of the last century, before prohibitive income taxes, there were many wealthy landowners, merchants, and businessmen who could pay almost any price for what they desired and go to any expense to build ranges of glasshouses to house their expanding orchid collections.

One of the most famous orchid growers of all time was H.G. Alexander of Westonbirt, England—grower for Sir George Holford. Sir George was a very wealthy man who lived and moved in Court circles. Often he would bring various members of the royal family to see his orchid collection. We read that the orchid displays and the flowers in cut flower displays were changed twice a day in Sir George Holford's mansion. Another collector of note in these early days was Sir Jeremiah Colman of Gatton Park, England. Sir Jeremiah was the Colman of mustard fame. He was quoted as saying, "The money I made was the mustard people left on their plates." "The Orchid World," a magazine devoted to orchids published for some years prior to World War I, carried an interesting story on Sir Jeremiah Colman and his activities. What is of a special interest, however, is a picture of the grand hall of his home which was truly a marble palace of a magnificence such as we can scarcely visualize today.

We ask, "Why have orchids captured the interest of the public almost as soon as the first orchids were brought in from the tropics nearly two hundred years ago?" Perhaps our first answer must be that there is more variety in the orchid family by far than in any other family of plants. The orchids we have come to know are of an endless variety of colors, sizes, shapes, fragrances, and growth habits. Even in the temperate areas of the world, millions of people know orchids from the thousands of species growing wild in the woodlands. We can say they have had their introduction if only to appreciate the Lady slippers of the northern woods. Even these are remarkable for their distinctive beauty.

The Royal Horticultural Society in England did much to further interest in orchids. At the various shows, private and commercial growers displayed their wares. Even today, the shows cannot be surpassed for number of plants and massiveness of displays. There is an account of a large horticultural exhibition in 1912 in which H.G. Alexander spent months preparing his display.

Propagation—A Serious Challenge

For most of the years orchids were grown, propagation was a serious problem. The tiny dustlike seed was often sown on the surface of the orchid potting mix or on a piece of turkish toweling stretched over wet brick. As the tiny seedlings germinated, they would be picked off and planted. One of the great milestones of orchid history was in 1922 when Dr. Louis Knudsen showed how these tiny orchid seeds could be germinated in flasks of sterile media if nutrients were provided. Here was a means whereby countless thousands of plants could be propagated quickly and easily. The orchid world entered a new era. The orchid world entered another era in 1960 when Dr. George Morel showed how a tiny shoot (a meristem from root or shoot) from a new orchid plant could be taken into the laboratory and propagated in the laboratory.

These little cells would grow and be periodically chopped into smaller pieces. In time, large numbers of plants of this exact variety could be propagated in a short time. The orchid world was introduced to tissue culture or meristem tissue culture as it is properly known. What does it mean? It means that the commercial grower can select a very fine variety, propagate a great quantity of it quickly and cheaply, and sell that plant so that you have exactly what you want at a very low price compared to what you would have had to pay for it before tissue culture.

Where are we in the orchid world today? What is there for you to enjoy? Now you can have, with ease and with relatively little cost, an infinite variety of the finest orchids from throughout the world. Species, of course, are still available in their charming and unusual variations and the modern hybrids are of ever-increasing beauty and variety and many are fragrant. The hybridizers throughout the world are working to create even more beautiful orchids. The beauty is still there; their romance and mystique are still there; all that has changed is that it is easier for you to enjoy. ❦

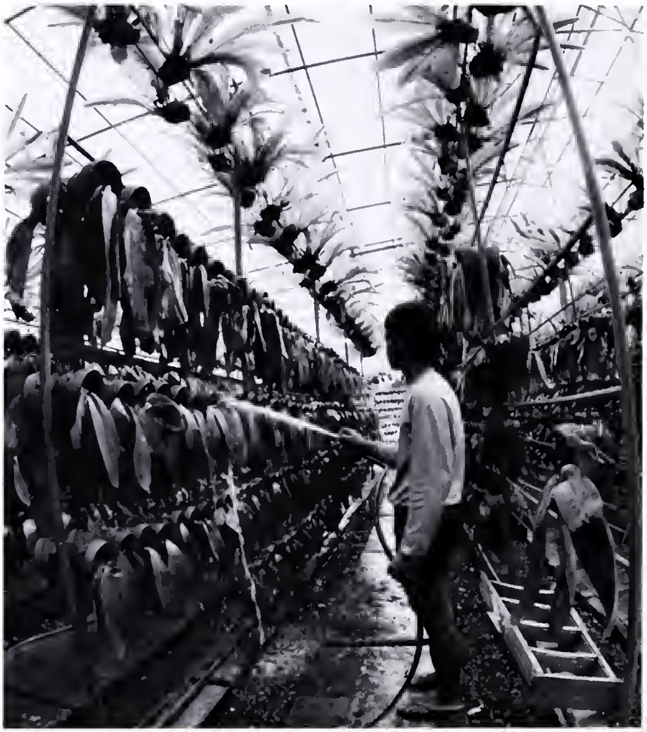
Orchid Heritage

Orchid growers treasure the original species which come from tropical regions of the Old and New Worlds. In modern times the pressures of development and politics threaten habitats of our most precious orchids, yet knowledgeable individuals in tropical countries often strive to protect the remaining plants.

These photographs feature examples of orchids in the tropics, wild and cultivated. The survival of orchid species in the tropical world is often related to how these species are appreciated by local growers and politicians. Effective protection follows interest, love, and a desire to save the unique orchid heritage of tropical regions.

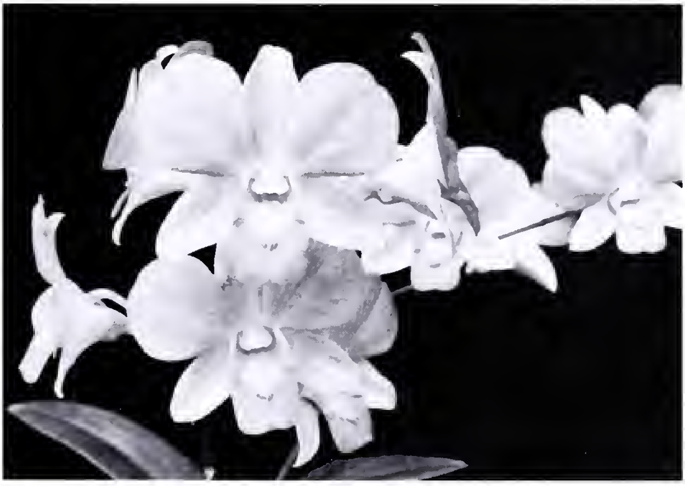
Shat Lun Cheng of Green Orchids in Taiwan studies meristem plantlets grown from a superior orchid clone. Such modern propagation techniques assist in the conservation of rare species and superior hybrids.

Orchid students gain firsthand understanding of rare species by observing specimens in jungle habitats. Here Philippine species expert Andres Golamco, Jr. searches for orchids in the jungles of Luzon.

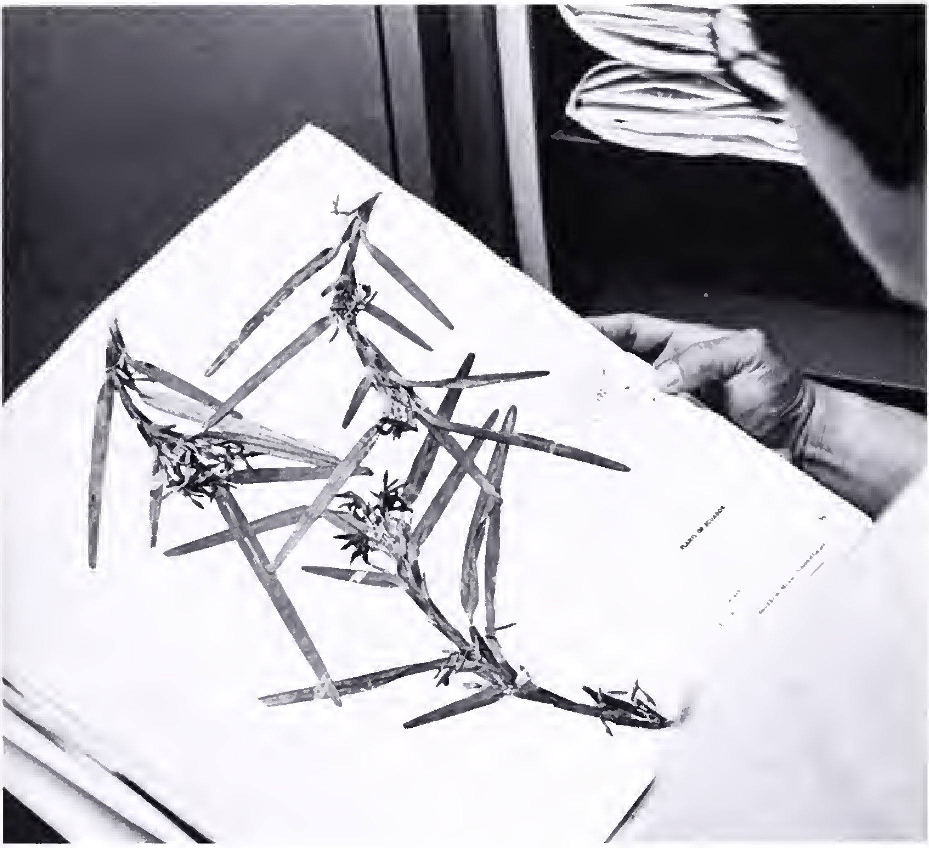


Bird's-nest ferns provide cool shade for establishing species *Phalaenopsis gigantea* plants at Rasa Sayang Orchids in Jakarta, Indonesia. The orchids make new roots on fern root chunks in clay pots.

Above, left, soaking *Phalaenopsis* orchids at Rasa Sayang Nursury in Jakarta, Indonesia, is required every few days. Select clones of rare species are propagated by self-crossing and meristem (tissue) culture. Above, right, grower Duan at T. Orchids in Bangkok studies one of the cut-flower *Dendrobium* hybrids now seen around the world as an export crop. Below, *Dendrobium* Terri Ann Hasabe, a pink hybrid grown at T. Orchids in Bangkok, Thailand.



Above, slash and burn destruction of jungle, here in the Amazon region. Orchids are losing habitats rapidly. Below, typical of habitat loss to agriculture in the tropics is this jungle in Malaysia where trees are being cut to clear land for oil palm cultivation. Orchidist Michael Ooi holds some *Phalaenopsis violacea* he salvaged from felled trees.



THE CLASSIFICATION OF ORCHIDS

Phillip Cribb

Biological classification is the direct result of man's attempts to come to grips with the vast numbers of living organisms in the world. In the Plant Kingdom alone there are estimated to be 250,000 species of flowering plants. Of these, some seventeen thousand are thought to be orchids according to Willis (1973) and Dressler (1981) while other authorities suggest that this figure might be on the low side. Whatever the exact figure, no one can deny that there are far too many for anyone of us to remember or even begin to know without some help. That help is provided by recourse to one of the many classifications

This orchid herbarium sheet is typical of orchid reference specimens used in traditional classification studies.

of the orchids—schemes which seek to arrange the various orchids in some sort of easily accessible order.

Simple Classifications of Orchids

Not all classifications are complicated. Indeed some of the most widely used are the simplest and oldest. Every grower of orchid species uses classifications of various sorts in dealing with his collection. He may have several glasshouses each with a distinct environment—cool, intermediate and warm, for example, and will separate or classify his orchids into those categories so that each can be grown under the conditions best suited to it. Even the grower with a single glasshouse will know that some parts of his house suit certain orchids better than others and will place his plants accordingly.

Perhaps the most widely used distinction made by orchid growers is between terrestrial (land grown) and epiphytic (grown off the ground) species. Terrestrials will often be grown in a soil-based compost while epiphytes will be grown on bark or wood blocks or in chopped bark in pots or hanging baskets. All these methods of categorizing plants are forms of classification!

All these classifications are based on one, or at the most, a few features of orchids. Each is useful but only within its limited brief. They are called artificial classifications and often group together quite unrelated or unlike orchids.

The history of orchid classification is one of the production of schemes that tell us more about the orchids incorporated into them. The earlier schemes of the nineteenth century attempted to group "like with like" while the more ambitious classifications of recent years have attempted to group together orchids that are related in an evolutionary sense.

The Species—The Basic Unit of Classification

In all classifications of living organisms, the basic unit used is the species. A typical definition of a species is that given by Jeffrey (1982) as "a series of similar intergrading and interfertile populations recognizably distinct from other such series, and separated from other such series by genetically controlled barriers preventing interbreeding." For animals, this definition of a species is relatively easy to apply. However, for plants, and orchids in particular, it is often impossible to provide information on breeding behavior and we usually have to rely on the far more subjective notion of morphological similarity to define the species. In other words, if two orchids look alike then they are assumed to belong to the same species, if not, then they are assigned to different species.

This is not always a satisfactory method of delimiting a species because plants of the same species can and frequently do vary, the major causes of variation being the effects of environment, mutation, and genetic recombination. Nevertheless, in most cases, orchid species are delimited on morphological grounds alone. [Classified according to structure, mainly of flower parts. Ed.]

Categories Above the Species Level

The base unit of classification is the species but there are several other categories at higher ranks that are also used. These categories, arranged in ascending order, are genus (plural genera), subtribe, tribe, subfamily, and family. The use of a particular category reflects on the similarity and relationship of the constituent elements. Thus species that are closely allied and morphologically similar are placed in the same genus. Some degree of crossability, which in orchids may be considerable, is also indicated. Species that are relatively distinct and not closely related are placed in different genera. The degree of cross compatibility is generally less than between species of the same genus and, indeed, is usually non-existent in unrelated genera.

In orchids, the genera are usually grouped into subtribes, the subtribes into tribes and the tribes into subfamilies. In Dressler's system, mentioned later, there are six subfamilies recognized. Of these the Apostasioideae and Cypripedioideae each comprise a single tribe while the Spiranthoideae has two, the Orchidoideae and Vandoideae four each, and the Epidendroideae six.

The rank of the categories from subtribe upwards can be recognized by their Latin endings as follows:

Category	Latin Ending	Example
Genus	Any but usually *-us, -a, -um*	*Anguloa*
Subtribe	*-inae*	Lycastinae
Tribe	*-eae*	Maxillarieae
Subfamily	*-oideae*	Vandoideae
Family	*-aceae*	Orchidaceae

The Beginnings of Scientific Orchid Classification

The species concept was well established by the time scientists began to realize the wealth of orchids in the world. During the late eighteenth and early nineteenth centuries orchids flowed into Europe and particularly into the British Isles from all over the world. In particular, as the tropics of India, Southeast Asia and the Americas were opened by intrepid explorers and collectors, exotic orchids flooded into Britain and the mania for growing orchids began. John Lindley (1799-1865) was ideally placed in London to see these orchids firsthand and he rapidly became the acknowledged expert on orchids, naming upwards of three thousand species. H.G. Reichenbach (1823-1889), his successor, named many more. Estimates now of the number of orchid species range from fifteen to thirty thousand—far too many for any one person to deal with, let alone remember. The need for classification or scheme to deal with these vast numbers and to bring them down to manageable proportions became ever more apparent. Lindley in his *Genera and Species of Orchidaceous Plants* (1830) produced the first significant scientific classification of the family. The botanical features that characterize the orchids as a family are found in the sexual parts of the flower, in particular, the column that bears both the male (anthers) and female (stigmas) organs. Lindley distinguished seven major groups within the family, based on their column features, in particular the number of anthers, and the manner in which the pollen was held in them. George Bentham (1800-1884) in his and Sir Joseph Hooker's *Genera Plantarum* (1883) expanded upon Lindley's classification to produce a more detailed treatment that was widely accepted.

The first major departure from classifications that relied almost entirely upon the characteristics of the column was that proposed by Ernst Pfitzer (1846-1906) in Engler's *Pflanzenreich* (1895). His scheme incorporated vegetative as well as floral characters. Rudolf Schlechter's classification scheme published in *Notizblatt des Botanischen Gartens Berlin, Dahlem* in 1926, incorporated many of Pfitzer's ideas as well as those of Lindley and Bentham. Schlechter's classification has been widely followed since it was published. Like its predecessors, it attempts to place like with like by assessing a number of morphological features both floral and vegetative. The result is a useful scheme in which the major divisions within the family are firmly outlined.

The ideas of Charles Darwin on the evolution of living organisms outlined in *On the Origin of Species* (1860) have not unnaturally exercised a great influence over the thinking of botanists. At first, the temptation to suggest that similarity necessarily meant relationship led to various classifications based upon overall similarity being given evolutionary overtones. Convergent or parallel evolution is, however, widespread in the orchids. Quite unrelated species can look alike, e.g., the habit of *Angraecum distichum* and *Dendrobium leonis* and the flowers of *Cattleya, Sobralia* and *Epistephium.* Therefore, more recently, fresh attempts have been made to produce classifications that better reflect evolutionary relationships. Parallelisms, for example, can frequently be identified by assessing large numbers of characters.

Modern Orchid Classification

The most recent and thoroughly worked-out classification is that of Dressler in *Orchids, their Natural History and Classification* (1981). Evidence from floral and vegetative morphology, anatomy, cytology, and crossability have all been used to construct the classification. In it he recognizes six subfamilies. The Apostasioideae, with two or three anthers, are a primitive group comprising two genera seldom seen in cultivation. The Cypripedioideae, the well-known slipper orchids, are similarly rather primitive with two anthers and a characteristic slipper-shaped lip. The remaining four subfamilies, the Spiranthoideae, Orchidoideae, Epidendroideae, and Vandoideae, all have flowers with a single anther. The vast majority of cultivated orchids belong to the last two subfamilies. These contain the majority of the epiphytic species, which themselves comprise the majority of the orchid family. The Epidendroideae contains genera such as *Cattleya, Laelia, Sophronitis, Coelogyne, Vanilla,* and, of course, *Epidendrum* itself. The Vandoideae contains genera such as *Cymbidium, Oncidium, Odontoglossum, Miltonia,* and the monopodial orchids such as *Vanda,* and *Phalaenopsis.*

Although Dressler's system is essentially a natural classification, he does suggest that his arrangement reflects the evolutionary advance of the orchids from the Apostasioidea, with species that have most primitive features, to the highly evolved and advanced members of the Epidendroideae and Vandoideae. There are nevertheless species in each subfamily with primitive features suggesting that the evolution of the family has been reticulate rather than straightforward.

New methods of analysis, such as cladistics (a way of constructing or developing ideas about the evolutionary history of a group of plants that can tell us about the evolution of features and hence the classification of the group), will no doubt clarify areas within such classifications as Dressler's. However, it is fascinating to see how much in common his classification has with the early efforts of Lindley.

How a Classification Can Help the Grower

It is easy to see how artificial classifications that divide orchids into such groups as terrestrial and epiphyte; cool-, intermediate- or warm-growing; clustered or creeping habit, and others can help the grower. It is perhaps less easy to appreciate how a modern classification such as that of Dressler can be of use to the grower.

The modern classification attempts to place together orchids that are related to each other in terms of overall similarity and in an evolutionary sense. The compatibility of species in such genera as *Cattleya, Laelia, Sophronitis, Schomburgkia* and *Epidendrum* is well known. Not surprisingly we find these genera closely placed in Dressler's classification. The juxtaposition of genera in his classification might well suggest to the hybridizer fresh possibilities for his crossing program. For example, Dressler lists fifty-seven genera as closely allied to *Oncidium* and eighty-six genera to *Phalaenopsis*—surely the building blocks lie here for future hybridizing programs.

Close proximity in a classification may also give the grower clues to the cultural requirements of a species new to his collection or to its sensitivity to various chemical sprays provided he knows the requirements of allied species.

Every grower wants his orchids to be identified and named correctly. It is here that classification and an understanding of relationships can help. If the grower recognizes in an unnamed plant features common to other plants in his collection it will enable him to place the plant in its correct genus or, at least, close by. Reference then to the right section of one of the many excellent identification manuals will usually enable an accurate identification to be made fairly rapidly.

Orchid classification then is a man-made aid to enable us to cope with the vast numbers of species in the orchid family. An understanding of how orchids are classified can help the grower to understand his plants and that undoubtedly will lead him to grow them better.

Further Reading

Dressler, R.L. (1981). *The Orchids: Natural history and Classification.* Harvard U.P. vard U.P.

Jeffrey, C. (1982). *An Introduction to Plant Taxonomy,* 2nd ed. Cambridge U.P.

Schweinfurth, C. (1959). "Classification of Orchids." In Withner, C., *The Orchids of Scientific Survey,* 15-43. The Ronald Press Co., N.Y. ❦

OVERCOMING THE PITFALLS OF THE BEGINNER

M.M. Brubaker

Considering the ruggedness of the commonly grown orchids and the conditions tolerated in nature, such as long periods of drought, torrential rains, tropical sun, and almost nothing in the way of nourishment, one wonders why there should be any difficulty in growing them. Some of the difficulty may be psychological. The delicate and intricate appearance of the flowers and the awe that surrounds this family of plants leads the beginner to think that their growth must require meticulous skill. A little study of their peculiarities and attention to a few details are all that are needed to grow some of the showiest orchids. It is mainly a matter of "bother," and I am listing below some things worth bothering about.

Watering

For the beginner, the most difficult aspect of orchid growing is watering. To understand this, one must appreciate the difficult transition, for the epiphyte orchid, from the tree limb, where the roots are constantly exposed to fresh air, to the greenhouse pot. The roots must have fresh air even if drying of the surrounding material is necessary to let it in. There is consequently a close relation between the potting medium and the watering technique. A change in the potting medium usually requires altered watering practice.

Beginners are inclined to make rather impulsive changes in the potting medium. A great variety of media have been successfully used. The British grew magnificent orchids for more than half a century in mostly peat and sphagnum moss. Media as different as lumps of fir bark, fern root, coconut husks, and gravel are used today, and each requires a different watering practice. It is best to stay with a selected potting medium until proper watering has been learned, and then make any change cautiously.

Beginners often start with cattleya-type orchids, and watering too frequently, without allowing the roots to become well aerated, is their most common mistake. Well established orchids in proportionately small pots and in active growth can be watered more frequently. Plants with much reduced or no roots prefer frequent misting of the foliage.

As the potting medium ages and breaks down, watering becomes a much more critical matter. Often the beginner is found struggling with a gift orchid that needs repotting in fresh medium rather than skill in watering. With cattleya-type orchids and many others, light-colored roots "crawling" on top or near the surface of the medium, and plump front bulbs indicate proper watering.

A corollary mistake of beginners, when they realize they are overwatering, is to cut down on the amount of water rather than the frequency of watering. This can lead to an accumulation of salts from evaporation of water and from fertilizer residue. Orchids need to be drenched periodically to leach out any accumulated salts, then allowed to dry out before being watered again.

Problems in Potting

It is a frequent mistake of beginners to change the nature of the potting medium without cleaning out the kind previously used. A particularly objectionable situation arises when a plant grown in osmunda is given a roomier pot in which fir bark is used to surround the old root ball. A fir bark watering practice will then surely rot the roots that are left in osmunda. The old osmunda should all be picked out before repotting in bark, no matter how tedious the job seems.

"Potting on," or surrounding the old root ball with fresh potting medium, is an acceptable practice if the old potting material is of a durable type and in good condition, and if the same kind is used. With fir bark, "potting on" is generally undesirable.

Failure to Bloom

Failure to bloom in healthy-looking orchid plants is most often the result of too little light. There seems to be a misconception that orchids enjoy the gloom beneath dense vegetation. On the contrary, many cattleyas, laelias, dendrobiums, oncidiums, vandas, and epidendrums flower most abundantly when they receive sunlight for at least part of the day. When grown in heavy shade, these plants have dark green leaves and do look better. However, the leaves which grew up in the shade will blacken when exposed to high light, furthering the misconception that orchids resent strong light. It can be somewhat of a task to accustom a shade-grown plant to the high light necessary for abundant bloom.

Let There Be Rest

It is often essential to rest orchids for good bloom or for proper growth. Some of the commonly grown orchids do not need a real rest, although they have periods of less active growth when they should have less frequent watering. Ignoring or slighting a rest period does become a pitfall when the beginner grows such orchids as dendrobiums, catasetums, cycnoches, and some oncidiums and odontoglossums.

Many dendrobiums must have a comparatively long rest period with very dry or cool conditions to initiate flower buds. Often the novice cannot bear to give his plants drastic enough conditions to obtain good flowering.

Cycnoches grow very actively in summer and require heavy watering. They then flower and rest. The bulbs are inclined to rot unless they are carefully dried during the resting period. It is important to wait until the new growth has roots before watering normally.

Many orchids require a rest period of reduced watering to prepare them for renewed activity and to preserve their normal yearly cycle of growth. These come from areas where there is an extended dry season and they usually flower before resting.

Staking

Tall orchids can become quite disheveled if not properly groomed and supported. Dividing and repotting, particularly, are likely to yield top-heavy plants. For reestablishment, orchids must be held rigidly in the new growing medium. Staking is therefore essential, especially with such tall orchids as dendrobiums and cattleyas. I prefer the type of stake that grips the rim of the pot. It can be quickly made to fit a particular plant, is stable, and can be changed at any time without significant damage to the roots. A good wire bender costing a few dollars, with some #12 wire, will solve most of the staking and support problems in orchid growing.

Foliage Damage

Wetting the foliage on soft-leaved orchids can lead to alarming disfiguration and serious set-back in growth. The new growth on catasetums, cycnoches, lycastes, anguloas, and calanthes is particularly prone to rot if water is left between the leaves. This is especially difficult to deal with when these soft-leaved orchids are under hanging plants or under a bench. Some help can be provided by dusting the growing cup of leaves with a fungicide. Where possible, however, the best solution is to isolate the plants and keep the new foliage dry.

Pruning

A fear of cutting up orchids seems common amongst beginners. It leads to unsightly plants, oversized pots, and sometimes advancement of rot. Old bulbs and objectionable growths should be carved off at repotting time. It is best to dry the cut surface of the bulbs or apply a fungicide before potting. Conscientious growers *always* sterilize all cutting tools, usually by flaming, to prevent spread of virus. ◆

PAPHIOPEDILUMS, THE TROPICAL LADY SLIPPERS

Lance A. Birk

Paphiopedilums easily adapt to many growing conditions, including growing them in your own home. They will thrive and flower where many other orchids will not. Even if you have little experience in raising orchids, you will find that paphiopedilums offer some of the best rewards in the plant kingdom. They can be grown in a wide variety of potting soils and under artificial lights. Even some of the rarest species can be grown in the home, although a few need specific attention at certain stages of their growth. If you have a greenhouse or a separate growing room set aside for plants, your success at growing paphiopedilums will be assured. Another bonus is that there are seldom any insect pests and diseases are rare.

Not only does this genus offer a wide variety of exciting flower shapes and colors, but a diversity of plant sizes and some of the most beautiful foliage in the orchid family. Plants are mostly small (African-

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Above, *Paphiopedilum* Apache is a modern highly bred hybrid with typical round shape. The parents are *Paph.* Winston Churchill and *Paph.* Red Angel. This flower is a blend of burgundy, brown, and white.

violet size) and are attractive even when out of bloom. Plants multiply rapidly and offer the opportunity for frequent division and exchange with other orchid growers. With many species a single division can, within two year's time, produce a half-dozen separate growths. During the past fifteen years paphiopedilum species and hybrids have become readily available and can be found in most orchid collections.

Plants can be purchased from orchid nurseries and from mail-order firms as well as from other orchid growers. With all these fine attributes it is no wonder that paphiopedilums have enjoyed a tremendous burst of popularity. There are few plants whose flowers can last for more than a month, bloom every six months or produce consecutively flowering stems. Even with a small collection you can have paphiopedilum orchids in flower every day of the year.

Above, *Paphiopedilum curtisii,* a warm-preference pure species from Sumatra.
Below, *Paphiopedilum* Iowa is a modern hybrid bred for round shape and blend of green, yellow, and white colors.

Where Can I Grow Paphiopedilums?

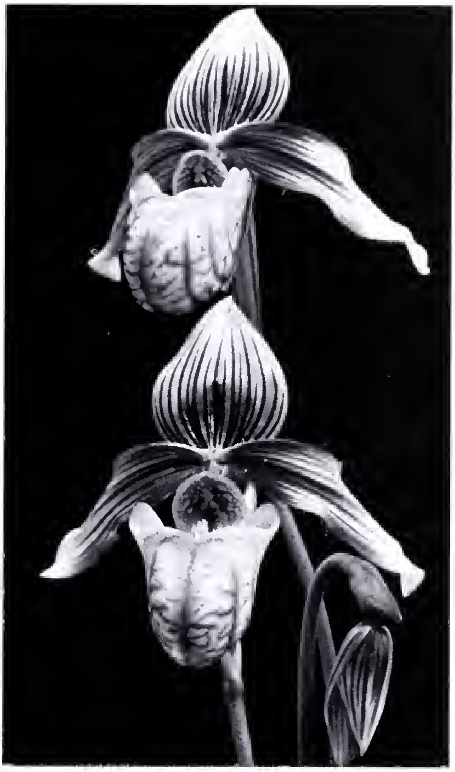
One of the physical characteristics that sets orchid plants apart from other plants is their stomata, or leaf pores, that are fixed open. This means that they are not able to regulate the loss of moisture. If they are grown in an atmosphere which is lacking in sufficient humidity, orchids become desiccated and lose their vitality. If grown in an excessively humid atmosphere they can become susceptible to fungus or bacterial diseases. Generally speaking, lady slipper orchids are happy in the same temperature ranges humans are comfortable in, with somewhat more humidity. Ideally, humidity should be at least 50 percent with some fluctuation during the day and night. During the heat of the day humidity drops, but as night approaches it rises and remains high until the air warms again.

Providing extra humidity need not be a problem if there are other plants being grown in the immediate vicinity. Water loss from soil, pots, and foliage furnishes some humidity. In the home, during the drier time of year, or when the heat is on during the winter, grow plants on plastic or metal trays filled with gravel and some water. If conditions permit, you might find a place near a bright window (direct sunlight must be shaded with a thin curtain). Basements can also be utilized for larger collections where they all can be grown under artificial growing lights. Paphiopedilum orchids are particularly adaptable for this type of growing.

Nearly all species and hybrid paphiopedilums will grow and flower in what is called an intermediate orchid house. Whether it is in the home or in the greenhouse makes little difference. Ideally an intermediate house will range from 50 to 60°F during the night. A cool house will range between 45 and 50° and a warm house will average 65°. During the daytime, while the sun is shining, a cool house will warm to 70° or more, an intermediate house to 80° or more, and a warm house can go above 90°. It is common for higher temperatures to be found in cool zones, or lower temperatures to be found in hotter areas, and these temperatures are not as important to the plants as are nighttime readings. You can see that the intermediate readings fall within the range of human comfort.

Paphiopedilums require a 20° (average) differential temperature between summer nighttime lows and winter nighttime lows in order to flower. In the home this may not always happen, so special treatment might need to be given to effect this. In the greenhouse it is an infrequent concern because of the naturally occurring fluctuation between summer and winter temperatures. Another problem encountered in growing plants in the home is the lack of sufficient light for certain species, or the lack of total numbers of hours for one or two in particular. When orchids are grown under lights the timer can be adjusted accordingly, but when grown at a window it may be necessary to install supplemental lighting. Usually this is found to be the case with only one or two difficult species.

These orchids need to have free air movement about them at all times. This



Paphiopedilum venustum album.

does not mean that they should be grown in a cool, drafty location, but that they need freely circulating air currents to carry away excess moisture. Leaves should dry off within an hour or so after they have been watered. If you find them still wet hours after being watered it means they are not getting sufficient air flow around them. At night, when temperatures drop below 60°, or during the day when temperatures rise above 85°, wet leaves are an invitation to diseases. Small fans, placed in strategic locations, will provide good air circulation. In the greenhouse fans should blow directly on the plants, but in the home the lower humidity can cause excessive drying so aim fans to blow above or away from the orchids. In many homes the lower humidity in the rest of the house draws away moisture from the plant room, thereby eliminating any problems of excessive moisture.

Since their light requirements are much lower than most other orchids, most paphiopedilums can be successfully grown and flowered in the home, usually near a window or other source of light. It doesn't have to be strong light in order to initiate flower buds since many buds are initiated by temperature drop and a rest period. Most species are found in rather shady jungle habitats and are particularly suited to growing under artificial lights. Paphiopedilum hybrids have basically the same light requirements as the species. Those species which need strong light in order to flower include: *P. philippinense, lowii, stonei, praestans, randsii,* and *rothschildianum. P. delenatii* is peculiar in its needs. It requires long hours of sunlight as well as fairly bright light, which in northern latitudes may need to be supplemented with artificial means, especially during the winter months.

The best method of determining if your plants are getting enough light is by examining their leaves. Plants with dark green, droopy leaves aren't getting enough light. They are oftentimes more susceptible to injury or disease and become soft. Leaves which are light green, stand upright, or lie flat without drooping, and which are firm and strong to the touch are typical on plants grown in the correct amount of light. The more light your paphiopedilums receive, the firmer their growth and the more flowers they will produce. As with most orchids, paphiopedilums can be grown in very strong light; however, while they may bloom profusely, the plants will lose their beautiful foliage mottling, become reduced in size and look unattractive. What is needed is a balance between light and shade which will keep your plants looking good and continuing to produce numerous flowers. Paphiopedilum flowers lose their color in bright light, unlike many other flowers whose color is intensified. Also, longer flower spikes will develop in a shadier location so you might find that by reducing the light after the spike begins to develop will bring some much desired effects. Be aware, however, that in too shady a location the flower stems will droop and not stand up straight.

When Do I Water My Orchids?

One of the best means to determine when to water your plants is to knock one out of its pot to examine the root system. Pick a plant at random. Knock another out of its pot, or several others if you are not sure of what you are seeing. Not all plants are in need of water at the same time, but you will be able to notice if the potting soil is very wet, moist, or nearly dry. When you examine the roots of your plant you should look for fresh, whitish, fleshy root tips. There may not be many, but you will want to know if there are none. In this case there might be something wrong with the potting soil, your watering methods or perhaps it might indicate the time of year when there is relatively little root growth. Some plants normally produce massive root systems while others only make a few roots. This is why it is important to examine several potted plants to learn the habits of each.

If there are decayed roots and a smelly compost, and if most of the air spaces are clogged with decomposed bark or other ingredients, repot the plant as quickly as possible. At this time, it is important to recognize why the breakdown has occurred. The greatest single cause of root loss, and the death of orchids, is overwatering. If this is not so in your case, examine the compost ingredients to see which one is

Paphiopedilum venustum is a compact grower with marbled leaves, flowers colored with red, yellow, white and black.

decomposing so rapidly. Perhaps it might be caused by millipedes, which actually eat the compost. Perhaps you have placed a recently repotted plant alongside others which need more frequent irrigation and you unknowingly overwatered it. Maybe you watered the plant when it should have been at rest, or possibly it was placed where it couldn't dry off as fast as other plants nearby. As you can see, you must think like a detective and consider all possibilities. It's not difficult, it just takes a bit of doing.

Paphiopedilums are able to grow well and flower regularly in most any potting soil providing the watering frequency is controlled according to the density of the mix. A dense mix, one that is made up of fine, closely compacted particles, will hold more water for a longer period than a looser mix. There are growers who are "heavy" waterers, those who water often, as opposed to "light" waterers who do so infrequently. A heavy waterer should not use a dense potting mix for fear of smothering the roots of his orchids, and a light waterer should not use a loose mix for fear of starving his plants. If you can be home and in the greenhouse every day you might want to use a loose potting compost so that you can water your collection frequently. These orchids respond favorably to daily irrigation, but only if there is sufficient air movement and if the potting compost allows for rapid drying out.

If your schedule only allows you to be with your collection during the weekends then you probably will want to use a mix that holds water for a much longer period. Remember that these orchids like to be constantly moist, but never wet. Paphiopedilums are able to accommodate a wide variety of growing conditions which makes them ideal plants for beginners. It is wise to let a newly acquired plant adjust to your growing conditions for a few weeks before you change its way of life. If the plant was grown "wet" and you are a "dry" grower, or vice versa, the sudden change can stress it severely.

Well-grown plants which have not been repotted for several seasons will have developed a large root system, therefore need more water. Such plants can easily be watered every day without fear of damage to their roots. In fact, frequent watering may be needed in order to keep the plant growing. Sporadic, or infrequent, irrigation can cause the plant to begin its rest period at the wrong time or the potential for full growth can be limited. You should recognize the needs of these plants and contrast them with another plant which has been recently repotted. A newly-potted plant, even if it is the same size as the previous plant, will not be able to utilize water through its root system until it gets over the shock of transplanting. Time required varies considerably, but you will recognize its recovery when it begins to make new root tips. Newly potted plants will benefit from water being misted upon them rather than having water placed at their roots.

Plants potted in plastic pots will need much less water than a similar plant potted in clay. The difference in water needs can be considerable; as much as 3 or 4 times as much for clay pots. Inside a very bright greenhouse you will find that plants need more water than those growing in more shade. If the temperature remains high during most of the daytime plants will also transpire at a high rate. Air circulation is what causes water to evaporate from the pots and the stronger the air currents, the more water will be lost. Humidity outside the growing area has a great influence upon the rate of water transpiration. Low humidity outside will draw the moisture from the growing area very quickly, and in many instances you will find that trying to maintain proper levels of humidity can be difficult. During the cooler months when the heater is in operation, plants will lose moisture rapidly because of the rise in temperature. During freezing periods the cold will draw water out of the plants and potting soil, then condense on the roof where it may freeze.

Many factors influence the time for watering your orchids. If you pay attention to your plants and "listen" to what your plants are trying to tell you (rather than trying to "talk" to them) you will find that it isn't really too difficult to identify their needs and respond accordingly. In fact, if you want to grow these unusual plants you really must accept the responsibility of growing them well. Challenge yourself to do so and find the many happy rewards.

Which Potting Medium Should I Use?

A potting medium must offer support for the plant and keep it in place firmly enough so that its roots will not be injured each time the plant is moved. It must retain sufficient moisture so that the plant will not dry excessively during the interval between waterings. It must also decompose slowly. Ideally a mix should last for two or three years. This will provide enough time for the root system to develop. If the mix decomposes too rapidly your plants will need frequent repotting which will keep them in a state of transplanting shock for too long a period. A potting mix should also be inexpensive enough so you will consider repotting it when it actually needs it, rather than whenever you can afford to do so. Finally, a potting soil should be lightweight.

You will find that there are rarely two people who agree on potting mixes. Each person seems to have his own favorite (for the moment, anyway) and can muster convincing evidence that his plants are doing beautifully in this "magical mix." To all but an experienced grower this certain potting mix might represent the salvation of his deteriorating collection of plants. However, the most important factor is not the potting soil ingredients, but what they do for the plants potted in them. Equally important is the balance between the mix and air movement, light, and the grower's watering schedule, all the other factors previously mentioned. When you find a grower who is doing a great job of growing his plants, do not look at his potting mix, rather look to his methods of growing. Examine his watering techniques and his growing environment. If you find that you would like to copy his potting mix, you must also copy his methods of growing. It may mean that you might compromise somewhere, but that is all right since you must find the combination which will work for you. Whatever you do, you must resist the temptation to try a new potting compound sooner than every two or three years. It takes that long for a plant to really achieve its best potential after it has been repotted.

Among the more popular potting mixes for paphiopedilums is firbark, or other types of tree bark. Medium grade is most frequently used for mature plants and seedling grade bark is used for seedlings. To this bark may be added any number of other ingredients. Perlite or sponge rock, sand, gravel, moss, volcanic rock, marble chips, or bits of plastic chips are among other things commonly used either to cut costs or to add some missing nutrient which the plant might need. One of the most successful and easy-to-make mixes is straight firbark, plasterer's sand and chopped sheet moss. Proportions run approximately 8:2:1, by volume, according to the needs of the species being potted. Plants should be potted firmly using finger pressure only; a potting stick can damage roots. The special qualities of this mix are the variability of the water retention properties, its long life and the fact that it does not seem to produce toxicity as the components decompose. Also, you will find it practically impossible to overwater your plants, especially when you learn to fine tune this mix according to the needs of each species. Best of all, it is a very forgiving mix, particularly for beginners.

Pests and Diseases

While paphiopedilums are rarely bothered by most orchid pests, they are susceptible to some rather troublesome diseases. Fortunately these diseases are not widespread, but only cause problems in certain circumstances. The problem is cultural and therefore not difficult to remedy. When the temperature drops too low and the plants are wet, or when there is excess humidity and too little air movement plants are susceptible to diseases. Both fungal and bacterial diseases can cause considerable damage in a short period of time. Often a plant can be consumed overnight. Some diseases are not so rapid and a plant may be saved by immediate action, but you must act quickly to stop the spread to other plants.

The damage caused by either fungi or bacteria is very similar and, while the chemicals to treat each might differ, the basic form of treatment is the same. Symptoms to look for are brown or black watery spots on the leaf surfaces. Sometimes the tips of the leaves die back, or perhaps the whole center portion of the plant has become affected. These diseases are spread by splashing water or by insects and if any part of the plant comes in contact with any other plant, it too can become infected. The first thing you must do in either case is to isolate the plant. If it has been severely infected and the whole center crown is discolored, it must be disposed of in a sealed container outside the greenhouse, or other growing enclosure. If only a portion of the leaves has been affected you must remove them with a sharp, clean knife, cutting well into the healthy tissue. If there is any discoloration in the tissue it must be removed and discarded. Paint the cut with a fungicide and move the plant to a shaded location where there is good air movement. Do not water it for several days until you are certain that the disease has stopped. After two weeks you may return it to its growing location, but only if you are certain that there is no problem. An alternative treatment is a drench, where the whole plant is soaked in a bath of fungicide or bactericide, then removed to a shaded location, etc. The drench is actually a more thorough treatment, but be certain to let the plant dry off for six to eight days before watering it again.

Aphids and mealybugs are the two most bothersome pests. A sharp spray of water, from a misting nozzle will dislodge most aphids and if they recur, or if you have trouble with mealybugs you will need to use one of the insecticide sprays. Soil millipedes, snails, scale and any other nuisances can be eradicated with an application of garden pesticide. While these orchids may be exotic, the controls for their insect pests are found in most households. ❦

CATTLEYA CULTURE

Ned Nash

"Everyone knows how to grow cattleyas." This assumption has probably led to more cultural errors, especially on the part of beginners, than any other orchid myth. It should be stressed that although the various elements of culture will be discussed in separate sections, this is simply for convenience and ease of understanding. *All* cultural factors are equally vital to the successful growth of the plant. In addition, no one factor may be separated from the others. That is, all facets are interrelated and should be in harmony, one with the others.

Light

Cattleyas require good light to grow and flower properly. Insufficient light is the most common cause of failure to bloom. There are other diagnostic features that will help to clarify the nature of the problem. If the foliage is a dark glossy green and the new growth is thin and weak, requiring staking, the plant has been grown

Above, cattleya hybrids are available in many combinations of color. Seen here are yellows, whites, reds, and lavenders.

with too little light. The foliage should be a medium olive green and the growths and flower spikes should develop strong and erect, without the need for staking.

Because light is essential to the chemical reactions which produce a plant's energy, a plant receiving too little light will draw stored energy from the older portions to subsist and to "manufacture" new growth. Since there is a net loss in any energy transfer, new growth will become increasingly weak until the plant finally succumbs.

Optimum light conditions will vary from region to region. In areas such as Florida or Hawaii, cattleyas may be given nearly full sun, while in California, plants are best grown with 40–50 percent sunlight. This is a good example of why close observation of plant growth is a better indicator of proper light conditions than relying on a light meter. In nature, cattleyas grow near the edge of the forest canopy where they receive bright, dappled sunlight. If they are exposed to full sun, they burn, just as they would in cultivation. It is not the light itself that will burn the foliage, but the heat buildup caused by the light. Overheating the foliage is the limiting factor in windowsill culture of cattleyas because it is difficult to provide sufficient light to the plants without overheating the foliage. Even if the leaves don't actually show the symptoms of burning, physiological processes may become so stressed that the plant will grow poorly. This is why the smaller-growing cattleyas are so popular for windowsill culture; it is easier to provide them with sufficient light without overstressing the plant.

A word of caution: plants that have been grown with too little light will burn even more quickly than those that have been grown with proper light. Remember your first day at the beach after a long cold winter? The fact that the dark green foliage will draw heat even more quickly only exacerbates the problem.

A good test for heat buildup is to feel the leaf with the palm of the hand. The leaf should be cool to the touch. If it is warm or hot, the temperature should be lowered. A temporary solution, especially if one lacks artificial cooling, is to increase air circulation and spray the plants lightly overhead.

Temperature

Light and temperature are closely related. In nature, cattleyas may be subjected to temperatures ranging from the low 40's to 100°F or more. Some knowledge of the species background of any given hybrid is helpful in determining which microclimate within your growing area is best suited to that plant. Most growing areas will have microclimates that can accommodate differences; for instance, it is warmer nearer the source of heat, plants needing more light can be hung nearer the glass, and plants needing less can be shaded by the larger plants.

Most cattleyas thrive with a temperature range of 55–60° nights and 75–85° days. The 15–25° differential between day and night is essential for proper growth and flowering. Many orchids, cattleyas included, have a metabolism that manufactures sugars during warm daylight hours, then utilizes them to complete the process during cooler hours. This point is important because unless a plant receives a cool, dark "rest" it will quickly exhaust its food reserves.

It is essential to stress common sense here. While cattleyas require a temperature differential to do their best, do not go overboard. Experienced growers have found that cattleyas do their best if the temperature differential is not too great and the temperatures are at the lower end of the spectrum. The plants will grow best and flower at maximum potential when grown to 80° during the day and 60° (or a little lower) at night. This regime does not stress the plants, allows them to grow under the most favorable conditions, and provides the best flower quality.

Flowers developed under even temperatures have the best size and substance because they have developed slowly and evenly. The commonsense aspect enters when one has to decide the best temperature range for one's own geographic area. Intense fluctuation of temperature is what must be avoided.

It is generally thought best to grow younger plants, especially those right out of flask, a little shadier and warmer. Not only does this give the younger and more fragile seedlings a better chance of survival, it gets them off to a "running start." Grow young plants with 65–68° nights. As they are potted on from flats into individual pots, provide 62–65° at night. When potted for the last time before first-flowering, move them into mature plant conditions. This method pushes the seedlings to an earlier first-blooming, yet gradually "hardens off" the plants so that they do not continue to require the higher temperatures and additional shade.

Effective temperature often consists of no more than proper ventilation and air movement. There should be just enough air movement to eliminate stale pockets of air. This will tend to maintain even temperatures throughout the growing area, and the elimination of the still pockets helps to avoid the fungal problems that can begin in such areas. In mild areas, higher temperatures can be mitigated in greenhouses by having a higher-ridged roof with vents at the ridge. In such cases, bottom vents are a useful addition, as the cool air can rise through the house and out the ridge vent as it warms. This also provides natural circulation of air without the use of fans.

In cooler climates, higher houses are undesirable because of the large volume of air that is necessary to heat. In smaller houses a fan is needed to provide more active air circulation.

With just a little practice, you can readily recognize by "feel" if the growing area is right. The area should feel light and buoyant. The air should be a pleasure to breathe, full of earthy smells with plenty of oxygen. If *you* feel good in your growing area, so will your plants.

Watering and Humidity

The second most common problem is improper watering. Most cattleyas have relatively thick fleshy leaves and thickened stems or pseudobulbs (water-storage organs). Plants possessing such characteristics have them to survive periodic dryness. A dry season in the tropics is one where it doesn't rain every day. Generally these dry seasons are during the cooler winter months.

In nature, cattleya roots are exposed and dry rapidly. The roots will not tolerate extended periods of wetness. The absorbtive layer of the roots, the velamen, takes up water like a sponge. When it is fully charged with moisture, no gas exchange can occur. This condition can rapidly lead to rot. Although we generally grow cattleyas in pots for convenience, their need for cyclic drying and wetting remains.

Coarseness of medium for good drainage duplicates the cyclic wet–dry nature of the plants' native habitat and provides the circulation of air around the roots that the plants require. Many growers tend to fuss over the plants and, consequently, many plants have succumbed to overwatering. Remember that cattleyas have evolved to be drought-tolerant and simply will not stand for too much water at their roots.

Several diagnostic tests can be performed to tell when cattleyas need water. Because clay is porous it breathes, hastening the drying of the mix it contains. For this reason clay pots generally require more frequent watering. The "sweating" of moisture from clay pots can give a hint as to whether the plant needs water. By lifting the pot, one can see whether a ring of moisture has been left where the pot was sitting. If there is a ring, there is plenty of moisture left in that pot. A trick that works well in both plastic and clay pots is to insert a freshly-sharpened lead pencil about halfway into the mix. If the wood is dark with moisture when the pencil is withdrawn, the plant does not require water.

Today's lightweight mixes in combination with the lightness of plastic pots can give valuable information on the amount of moisture present in the pot. Immediately after watering, lift the pot; it will be relatively heavy. Lift that same pot before you think it needs water; it should be relatively light. If it isn't the plant doesn't need watering. With a little practice, the weight and balance of a plant in a plastic pot can tell you just how much water is left in the pot.

Very few of us have either the time or the inclination to test each of our plants individually. If the plants are set up with pots of the same size together, and one remembers the intervals between waterings for a given pot size, the initial learning period can be greatly reduced. It is a good idea to double-check your presumptions on watering intervals every so often.

Seasonal influences are important factors in determining watering intervals. Areas like Florida and Hawaii experience seasonal variation in day-length and cloud cover, however slight. As one moves away from the equator, these factors become increasingly important. Plants will generally require less water during winter months owing to the reduced growth rate that results from shorter days, cooler temperatures, and the lower angle of the sun.

Longer and warmer days and the increased growth rate they bring will necessitate more frequent waterings. Not only are the plants in active growth with many new roots forming, but increased fresh air evaporates moisture more quickly. It is especially important to take advantage of this quickening growth in cooler or more northern climates. The growing season can be quite short in these areas and it is vital to utilize it efficiently. This requires monitoring the plants' water needs more closely to avoid slowing growth by insufficient water. Only when the plants' water needs are correctly met will the plants perform to true potential.

Adequate humidity goes hand-in-hand with proper watering practices. In nature, cattleyas are subject to fluctuating humidity. A good rule of thumb is to increase relative humidity when temperatures rise and to reduce it when temperatures drop. The increase of humidity with rising temperatures is necessary to keep the plant's increasing transpiration and water use from outstripping its capacity to supply water from the roots. Lowering humidity with lowering temperatures helps prevent atmospheric moisture saturation which can lead to fungal and bacterial problems.

Young seedlings require more water and humidity because they do not have the well-developed water-storage organs of mature plants. More frequent waterings are required; and if one is fortunate enough to be home to tend the plants during the day, the seedlings may be lightly misted as necessary.

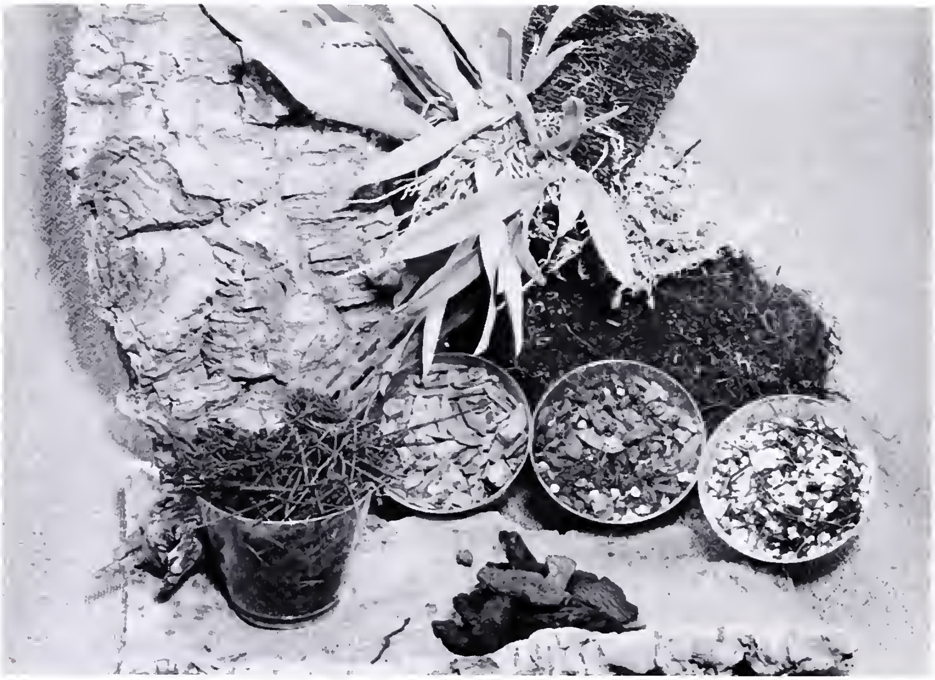
Fertilizing

In nature cattleyas grow on trees and rocks, which provide few nutrients. Fertilizer comes from many external environmental sources. Birds and other animals leave their droppings, leaves collect around the base of the plants, and nutrient solutions are washed over the plant from above by the frequent rains. Since the nutrients are supplied sparingly by outside sources, we can infer that cattleyas are moderate feeders. Most commercially prepared fertilizers for orchids should be used at one-half strength once a week.

Potting and Mixes

Osmunda, hapuu, firbark, charcoal, and many other materials share the desirable characteristics needed for cattleya potting material. One or another may work better in a particular area or for a particular grower, but all have relative merits and drawbacks. What works best for you and is cost-effective is the best mix. Give a fair trial to any new mix or material with which you are experimenting. This means

This *Rothara* seedling is ready for repotting. Materials to be used include pebbles, hardwood charcoal, coconut fiber, and wine corks.



Materials used for supporting orchids include, left to right at back, cork bark, treefern, osmunda fiber. In front, left to right, ground treefern, fir bark, fir bark mix with rough peat moss, redwood bark and perlite, mix of coarse perlite with ground treefern. In front are cork bark slab and hardwood charcoal.

a year, preferably two, using that mix before a final decision is reached.

It is wise to evaluate a mix *before* deciding to commit any of your plants to it. Factors to consider include: Convenience—is it easy to use? Is it readily available locally and is it likely to remain so? Finally, is it reasonably priced? If these questions can be answered to your satisfaction, give the mix a try.

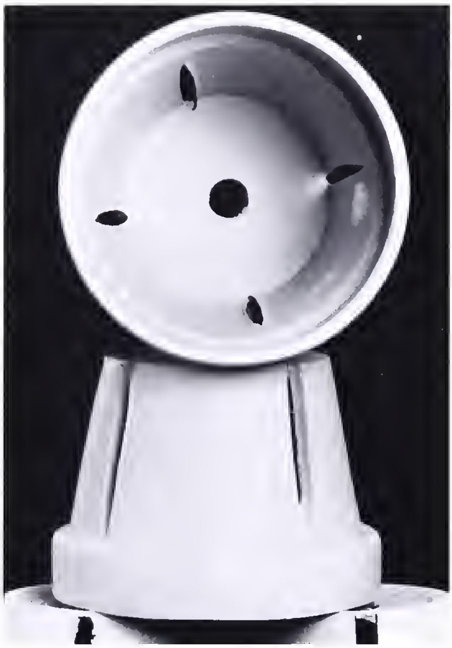
The majority of cattleyas in North America are grown in firbark and/or tree fern mixes. They provide drainage and aeration, and readily available commercially prepared fertilizers can be used to meet nutrient requirements.

Common sense dictates that a plant in bud should not normally be repotted. Not only will the flowers be poor, but the plant's strength will be sapped by having to open the flowers with little root system. If the plants *must* be potted while in bud, it is best to break off the buds to protect the plant's future productivity. A plant with mature leads that have already rooted is also a poor candidate for repotting. Waiting for fresh root-tip growth or a new growth will help to ensure the plant's speedy recovery from the shock of repotting.

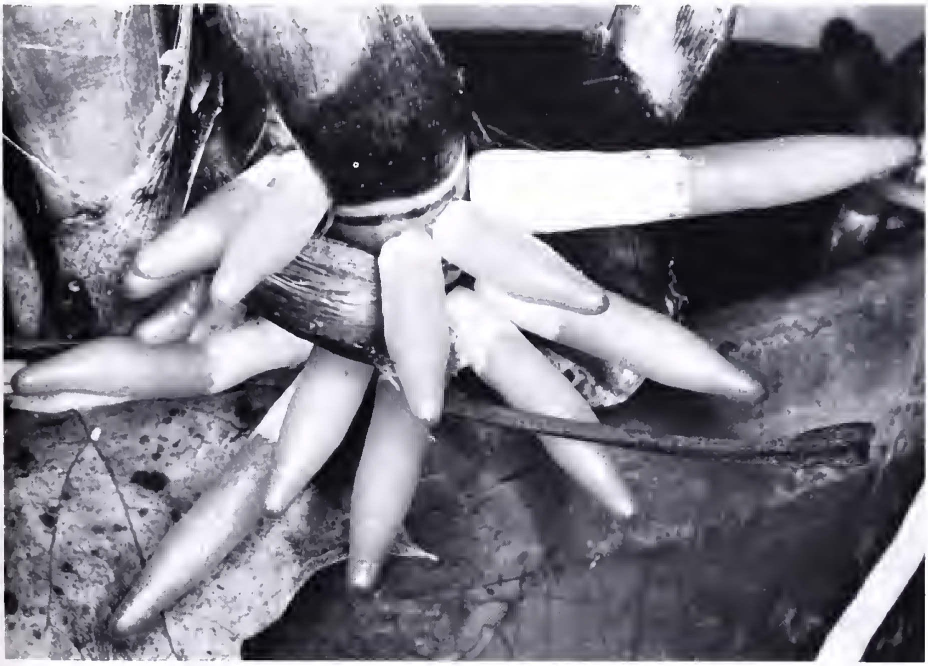
As one grows and learns from his plants, a sense of what to repot will develop. Observation of the plants throughout the year helps the grower to learn at what growth stages a particular plant, or type of hybrid, will sprout roots. Once this is learned, it is best to repot just before the new roots are initiated. This added precaution will prevent the newly emerging and very tender root-tips from being damaged in potting. Many times, if the newly emerging root-tips are lost, the plant will not grow any new roots from that growth and must wait until a new growth is formed.

A plant's flowering season will also influence when it is to be potted. Most spring-flowering varieties root immediately after flowering while fall/winter varieties root when the bulb is barely mature, some months before flowering. This can pose a bit of a problem if the plant begins to root while it is in bud. The only way around this is to pot when the plant is making new growth and hope that the shock will induce it to make new roots sooner than it ordinarily would. When potting, roots should be shortened to approximately 3–4″ to reduce the amount of old material in the new mix. With luck these shortened roots will branch, but often they may not. This is another reason why it is so important not to damage the root-tips on the new growth.

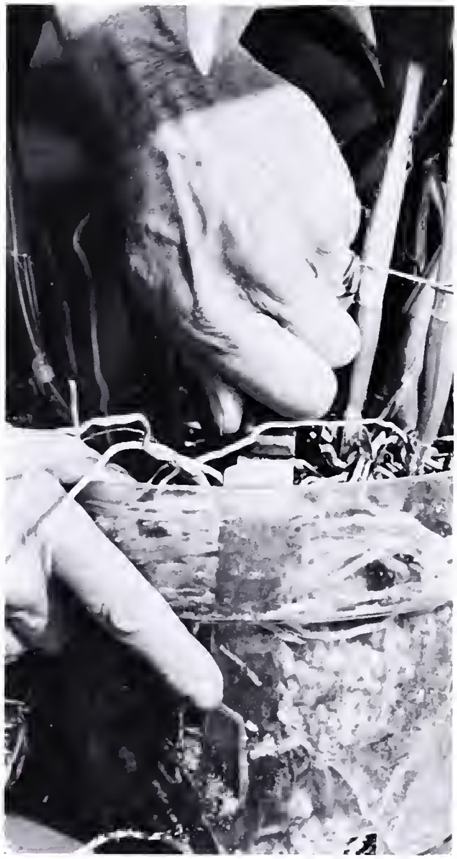
One of the most common mistakes in potting cattleyas involves improper placement in the pot. Most people seem to want to place the developing growth level with the surface of the mix at the expense of the back portion being buried. Because most cattleyas tend to climb a bit, that is each new growth develops relatively higher than the last, this habit of potting allows the plant to rapidly grow out of the pot, letting the roots and new growths be exposed to the air and pest problems. More properly,



Clay pots designed for epiphytic orchids.



New roots have begun to grow over the pot so this cattleya will need re-potting with special care not to break the new roots. Repotting just before roots begin is easier.



Use a clean knife to separate roots from old pot when transplanting cattleyas that do not easily come loose from their old containers.

a cattleya should lean across the pot with the rhizome level with the surface of the mix, the new growth nearest the center. The bulbs may lean forward, but the new growth will orient itself upright. It is important that the mix be uniformly firm throughout the pot to prevent any channels from forming where water might too quickly run through.

Pests and Problems

Cattleyas in modern collections suffer from very few pests. Their tough, leathery foliage is not attractive to sucking pests. Sensible use of available insecticides will take care of any minor infestations. It is never a good idea to spray insecticides as a prophylactic measure. One is encouraging resistant strains of pests by this type of usage.

Malathion is the insecticide of choice for most sucking insects. The tough foliage of cattleyas is not as adversely affected by the oil carrier as are many other orchids, and Malathion is effective against scale, mealybugs, and aphids. (Mealybugs are usually a more serious problem on young seedlings and dwarf hybrids because of their softer foliage.) Powdered wettable Malathion may be indicated in these cases because it does not need the oil carrier. Aphids can be an insidious pest because they usually attack only the flower buds, and these are easily damaged by either the oil base of the insecticide or the physical force of spraying. Insecticide residues are not desirable on flowers either. If the buds are not too advanced, a thorough spraying with plain water usually will dislodge aphids.

One application of an insecticide will rarely take care of the problem. Most commonly-used insecticides affect only one stage of an insect's life cycle. For this reason, three to four applications at seven to ten day intervals are recommended. We have not found systemic insecticides generally effective for cattleyas (except Cygon for boisduval scale). Our suspicion is that because cattleyas grow relatively slowly, the systemic is poorly or weakly distributed throughout the plant.

Soil-dwelling pests are a relatively minor problem in cattleyas. Snails and slugs do not care for the tough foliage, but they do relish flower spikes and buds. Regular applications of Metaldehyde granules will stop these pests. Sowbugs and/or millipedes will occasionally infest the mix. A Diazinon drench will stop this problem. Sowbugs can wreak havoc on mounted plants by eating the fresh root tips. A Diazinon or Sevin spray will prevent this.

Perhaps no other subject raises so much

controversy as virus in cattleyas. Virus is a serious problem in many cattleya collections around the world and at this time (1985) it cannot reliably be cured. It is very easy to spread a virus from plant to plant, and diagnosis of a virused plant from foliar symptoms is inexact (although you can make a good guess). You *must* disinfect your cutting tools after contact with each plant and heat (passing the tool blade through a flame) is the only sure method. Virus does not necessarily affect the vigor of a plant, although it may. Unfortunately, the more we learn about cattleya virus, the more plants we find infected with it—plants apparently free of the disease. This is probably the most disturbing aspect of the virus problem.

Flowering

It must be admitted here that while a nicely grown cattleya plant is an object of pride to its grower, it is really no more than a means to an end. The plant is grown well so that it will flower. And quite frankly, most cattleya plants are not really attractive when not in flower, even if they are extremely well grown.

Place the plant so that the lead growth faces toward the maximum light. This allows the buds to emerge cleanly and the flowers to open untwisted on the stem. Make sure that the buds do not become trapped in the foliage as they emerge. Many cattleyas will not immediately initiate buds into their sheaths and may seem to rest before doing so. This is especially true in spring-blooming varieties. Temperature fluctuation can cause moisture to build up in the sheath, leading to bud rot. This is often indicated by the sheath beginning to yellow and die. If this happens gently open and remove the sheath, taking care not to damage the young flower buds. The buds will usually still develop, but will need earlier staking because they do not have the support of the sheath while they are growing.

If the spikes require staking, do it as the stem elongates. Once the stem begins to elongate, do not move or rotate the pot. The plant should be left in the same flowering area until the flowers are fully ripe.

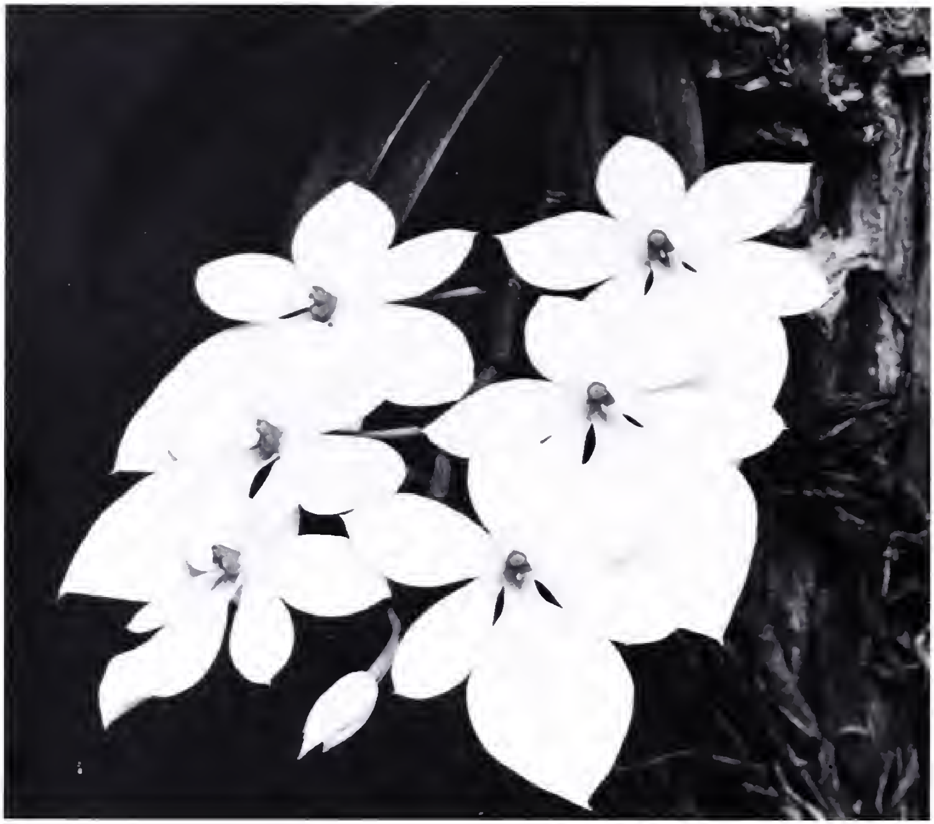
When misting or watering, try to keep water off the buds and blooms so as not to spot or bruise them. Any sort of chemical spray or dust should be avoided for the same reason. Flower buds are very tender and great care must be exercised not to bruise or damage them. What may seem an insignificant nick on a small bud will grow many times larger as the flower matures. Flower stems are also quite brittle as they grow and are all too easy to snap.

A bad orchid requires just as much time and effort to grow as a good one. With energy at such a premium today, growers simply cannot afford to grow plants that do not perform satisfactorily. Study hybrid lines and growth habits so that your orchid acquisitions can be intelligently, and successfully, planned.

The smaller hybrids available today have many advantages. Beyond the fact that they occupy much less space, their more compact growth habit allows them to receive more light without burning. Many will endure both cooler and warmer conditions than their larger cousins. Another advantage is that the smaller types tend to be more prolific in their production of new growths.

When evaluating a plant's growth habit, whether standard or dwarf, several things need to be considered. A relatively compact and freely branching habit is essential. Bulbs and rhizome should be in proportion to the general size category of the hybrid. A 2″ bulb size is no good at all if the rhizome is 2″ between bulbs and doesn't branch. Ease of growth is another factor to look for. If a particular type is known to be touchy about when it is potted, it is wise to avoid buying hybrids of this sort unless the other parent has been very carefully selected. It is smart to note whether the plant has flowered from most bulbs, or is it a "hit or miss" bloomer? Productivity is an important factor because the best cattleya in the world is no good if it won't flower.

Cattleyas are still the most popular of all orchids. An amazing array of colors, forms, sizes, and seasons all add up to a truly versatile group of plants. Outstanding cultivars are more easily and cheaply obtained than at any other time in history. Exciting new hybrids are being bred and offered at a greater rate than ever before.



Aerangis rhodosticta

ADAPTABLE MINIATURES

H. Phillips Jesup

Orchid horticulture in the twentieth century has been largely concerned with orchids of imposing size in both flower and plant habit. These familiar types, however, were derived from relatively few species in a handful of genera. Despite the public conception of the flamboyant orchid, the fact is that among the approximately 30,000 species of orchids, the majority are small in plant size, flower, or both, and growers who have space limitations or who are simply intrigued with small, collectible things will find a wealth of miniature orchids to choose from. Some have showy flowers so large they nearly obscure the plant that bears them, others have an abundance of small flowers, while some sport an element of whimsy.

A resurgence of interest in orchid species has led some orchid firms to offer a wide selection of the products of evolution, among which are a diversity of small species. As with many other plant families, wild orchid populations are subject to heavy pressure from habitat destruction and over-collecting, and conscientious horticulturists will prefer to obtain their plants from nurseries that have raised seedlings from self-pollination of their stock. The hybridizers too have taken note of the popularity of miniature orchids and have been active in breeding for compact plant habit. Their efforts have been most successful in the cattleya alliance, the resulting dwarf cattleyas being known as "mini-catts."

As is true of orchid species in general, the miniature species have evolved under a wide range of ecological conditions, from high mountains to sea level near-desert; cool cloud forests to lowland jungle; fully exposed lichen-covered rock faces; shaded, mossy tree trunks; tree-top twigs in open savannah forest. Often the plant form gives a valuable clue to habitat, and therefore to culture. Prominent pseudobulbs and thick or pencillike (terete) leaves function as water-storage organs and denote brightly-lit habitat with relatively low rainfall, at least at a certain season of the year. On the other hand, broad, thin leaves and pseudobulbs that are vestigial or lacking indicate a uniformly high level of moisture and shade in the habitat. Culture should dovetail accordingly. Species vary in their adaptability to "captivity," but most are amenable if their particular needs of light, humidity, moisture at the roots, and temperature are observed. Microclimates in the orchid growing area should be accentuated and utilized. In the home, for example, a sunny window would best suit *Leptotes bicolor* or *Oncidium onustum,* while a Wardian case exposed to good light but no sun, and with the top tipped up for ventilation, might provide optimum conditions for cloud forest denizens and *Aerangis rhodosticta.*

A drop in night temperature of at least 8 to 10°F is important for all orchids (as it is for most plants), and this is perhaps more easily achieved in a greenhouse than in the home.

Are miniature orchids more demanding in their care than their larger cousins? The answer is a qualified yes. While the cultural conditions for orchids from similar habitats are essentially the same regardless of the size of the plant, miniatures require closer attention. Small pots dry out faster than large, and the cork, branch, or tree fern mounts for some will need frequent watering or misting to keep the plants turgid because the roots, exposed to the air, will quickly dry. A miniature plant with a problem will usually succumb much faster than will a bigger one, since it takes only a few mealybugs or scale insects to suck much of the life juices from a tiny plant compared with hordes for a large orchid. A fungus or bacterial rot can obliterate a little plant quickly if undetected for a short time. Vigilance is important. However, for the enthusiastic grower such extra attention comes under the category of fun rather than work.

Before discussing a handful among the multitude of attractive miniatures, the temperature requirements of each species, which are shown after the botanical name, should be explained.

W = warm (day temperature 75–85°F, night 65°)

I = intermediate (day temperature 70–80°, night 60°)

C = cool (day temperature 65–70°, night 50°)

These are ideal temperatures to strive for, but some variation, as long as other conditions are good, should do no harm. All of the orchids below are, in general, adaptable to home and greenhouse culture within the ranges of their tolerance. They are from 2–8″ in height, except for a couple of the oncidiums which are vegetatively small but have bloom spikes up to 20 inches long. Species are listed in order of their temperature requirements, beginning with the warmer growers.

Warm-Temperature Miniatures

Aerangis rhodosticta (W) has a short, horizontal spray of 1-1/2 to 2″ narrow leaves with bilobed tips, from among which emerges a bloom spike on the same plane bearing six to ten or more 1-1/4″ flat flowers that face upward in a double rank. They are pure white with a prominent orange dot in the center of each. This is a shade-growing twig-orchid from Kenya

Ascocentrum miniatum

and the Cameroons, and will grow best with good humidity on a small cork slab or cut section of a rough-barked limb.

Ascocentrum miniatum (W), on the other hand, is a sun-lover. A double row of heavy, stubby leaves marked with dark dots clothe a slowly elongating upright stem. From the leaf axils each spring arise one or two 4–6″ "candles" of brilliant, closely-packed 1/2″ orange-yellow flowers. The white aerial roots are as thick as a pencil and as rigid. This Far East species should grow well in a bright spot in the greenhouse, on a south-facing windowsill, or close to the lights in an artificial light set-up. A related species is *A. pumilum* (I-C) which is but 1-1/2″ high, with needle-like leaves and tiny pink flowers.

Phalaenopsis rosea (W), formerly known as *P. equestris,* is a dwarf relative of the larger "moth orchids" which are popular commercial cut-flower and hobbyist plants. It produces a cloud of small rose-pink flowers with darker lips which appear to float on branched bloom stems above the three to five broad, flat leaves at the base of the plant. This one is a bit larger than most of the species discussed, and is of

Laelia pumila 'Dayana'

easy culture under conditions of warmth, shade, and moisture suitable for African violets.

Intermediate-Temperature Miniatures

Another relative of a horticulturally important group of orchids is the dwarf *Cattleya luteola* (I). A somewhat creeping species, the paddle-shaped thick leaves and pseudobulbs total about 6″ and resemble a scaled-down version of the familiar (and not very esthetic) cattleya growth habit. Clusters of three to eight yellow to greenish-yellow 1-1/2 to 2″ flowers erupt from a sheath at the top of the pseudobulb in the spring. The lips are marked with red. This species, found in Peru and Bolivia, prefers a resting period with reduced water after flowering, and requires bright light with some sun to flower well. Pots or mounts suit it equally, but be careful not to overwater pots.

Also in the Cattleya Tribe but quite different in appearance are *Leptotes bicolor* (I) and *Leptotes unicolor* (I). Both have pencillike round leaves, the former producing several spidery 2″ white flowers with magenta lips, and the latter uniformly pale orchid-lavender flowers about half the size. The leaves of *L. bicolor* are 3–4″ in length, while *L. unicolor* is a miniature version of its merely dwarf cousin. *L. unicolor's* rough-textured leaves and its flowers both grow straight downward. For this reason, it should be grown only on a mount, and if the plant is attached incorrectly with leaves pointed skyward, it will remedy that mistake, as subsequently-grown leaves will head sharply down. Both of these Brazilian species need bright conditions and not much water at the roots.

Laelia pumila (I) is yet another cattleya relative from Brazil and it resembles a dwarf version of a standard lavender florist's cattleya. The 4″ flower seems enormous coming from a plant about the size of *Cattleya luteola,* and it sometimes outdoes itself by producing two such immense flowers simultaneously from a single growth. Pot or mount culture suits it equally, but the somewhat creeping rhizome lends itself better to a slab of tree fern fiber; it will quickly "walk" over the edge of a pot. Strong light but a less pronounced rest than *Cattleya luteola* will induce flowering.

In the genus *Laelia* are a number of very tiny species which grow in declivities on the exposed rocky summits of several Brazilian mountain ranges. They, along with some larger relatives, are collectively known as "rupicolous (rock dwelling) laelias." Species such as *Laelia bradei* (I), *L. longipes* (I) and *L. lilliputana* (I) have butter-yellow, white, and lavender flowers respectively, and make entrancing pot plants. Their pseudobulbs resemble green or reddish bullets or marbles, and the extraordinarily succulent upright leaves are about 1/2″–1-1/2″, although they may grow a bit longer under less harsh conditions in cultivation. Their flower spikes emerge from developing growths and flaunt 1 to 4 flowers which face upward and are of narrow-segmented cattleya form. Bright sunshine and ample water at the roots during the growing season, once the plants are established, are essential.

Neolehmannia (Epidendrum) porpax (I) is definitely whimsical. The species is a mat-forming creeper, each stem bearing a single flower which at 1″ is large for the size of the plant. Its dominant feature is the lip which resembles a shiny red-maroon grape, the narrow greenish dorsal sepal and petals framing it like a corona of exclamation points. This Central and South American species is easy-to-grow and prefers to be mounted so that it can ramble. Moderate light suits it well.

From Southern Japan comes *Neofinetia falcata* (I), the "Japanese Wind Orchid," a wonderful species for those who appreciate fragrance. Its cluster of showy pure white flowers exudes a very strong sweet scent at night, sufficient to perfume a room. The lack of color, the evening scent, and the long nectaries lead one to assume that the flowers are pollinated in the plant's native habitat by a species of moth. Vegetatively this orchid resembles a narrow-leaved *Ascocentrum miniatum,* but it does not require quite as much sun. The species has been hybridized with related genera to make a fine series of plants which, although a bit larger, are still dwarf, and bear flowers of rose-pink, orange, coral, and lavender-blue—although with little or no fragrance.

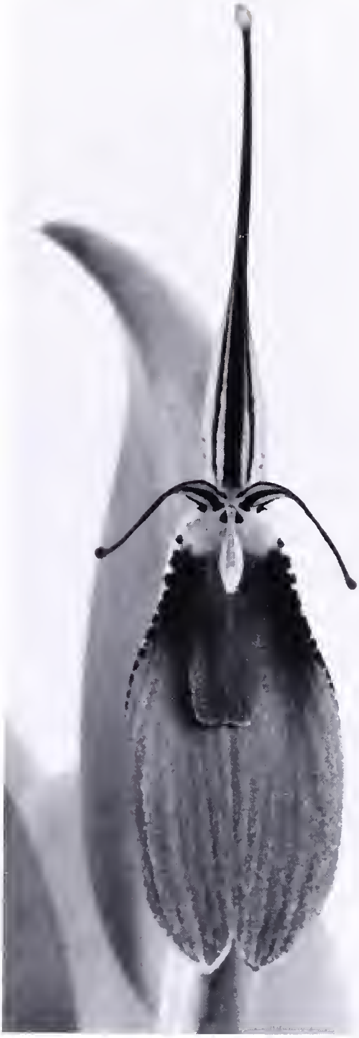
Sophronitis coccinea 'Edelweiss' grown by Phil Jesup won an AOS Award of Cultural Merit.

Neofinetia falcata

While *Oncidium onustum* (I) has been known to grow epiphytically upon cacti in dry areas of Ecuador, harsh native growing conditions do not seem to have resulted in a demanding plant. Although it is small, with short, heavy leaves and fat pseudobulbs, both red-mottled, the gracefully arching flower spike can reach 20″. It bears many 1″ flat golden-yellow flowers in a double rank, the lip comprising 75 percent of the flower. It revels in very strong light, and when it is in active growth *Oncidium onustum* requires frequent watering combined with rapid drainage such as it would receive on cork or tree fern mounts. Water should be reduced after flowering.

The West Indian equitant or fan oncidiums, of which examples are *Oncidium pulchellum* (I), *O. variegatum* (I), *O. guianense* (I), and *O. triquetrum* (I) are a group of jewellike species. The flower colors of those listed are lavender, white-and-brown, yellow-and-brown, and red-and-beige respectively. Bloom spikes of varying length depending on the species issue from 2–4″ fans of narrow, hard, channeled leaves and bear clusters of 3/4–1-1/2″ blooms. The spikes often rebloom several times by producing accessory branches. Culturally, they require good light and excellent drainage on a mount or in a very small clay pot, combined with frequent watering. Hundreds of hybrids, many spectacularly colored and patterned, have been made within this group and require identical culture.

Oncidium Catherine Wilson (*O. triquetrum* x *O. pulchellum*)



Restrepia cuprea

Similar in growth habit to the above but very different in flower is *Ornithocephalus bicornis* (I). The tiny, intricate white-and-green flowers are produced from a perfect fan of soft leaves which may orient itself sideways or upside-down. The flower structure resembles a bird's head and beak, and the generic name means "bird head" or, to some, "bird brain"! Shade and moisture suit this species, which is found in Mexico.

Easy to grow and generally available in the trade, *Pleurothallis grobyi* (I) of the American tropics is a representative of the myriad of genera and species in the Pleurothallid group. A true miniature, its wandlike racemes of tiny chartreuse flowers rise well above the 1/4″ fleshy, orbicular leaves. Moderate light and frequent watering, combined with the good drainage that all orchids need, will maintain this species in good condition on a mount or in a pot.

Trichocentrum pfavii (I) from Costa Rica produces its 1-1/4″ brown, white, and rose flowers with frilly lips, several to the growth. The leaves are short and thick, and it too can be grown in moderate light on a mount or in a pot.

Intermediate to Cooler

Flowering best in the cooler end of the intermediate temperature range, *Dendrobium bellatulum* (I-C) is a handsome miniature. Stumpy pseudobulbs are clothed with several silvery-gray leaves, and from the top, one or two surprisingly large, showy flowers emerge, generally in the fall or winter. White sepals and petals frame a spectacular lip, which is deep orange at the base becoming pale egg yolk near the end. It performs best with high light and needs a drier rest prior to flowering, corresponding with the end of the monsoon period in its native Thailand.

Dryadella lilliputana (I-C) looks like a tiny green pincushion studded with 1/4″ flowers resembling tiny three-legged starfish, yellowish with dark dots. A slightly larger version is *Dryadella edwallii* (I-C). Both occur on scrubby trees in areas of Brazil and enjoy moderate light and a fair amount of water. The generic name refers to the Dryads, the mythical elves of the forest.

Oncidium cheirophorum (I-C) is a lovely dwarf species that is a pleasure to grow. Chunky dark-speckled pseudobulbs and short, thin leaves are the backdrop for late fall flowering of 6″ branched spikes holding myriads of highly fragrant small flowers, the mass resembling golden yellow popcorn. Growing on trees along middle-elevation streams in Costa Rica and Panama, this species requires bright light and frequent watering in small pots.

Almost insectlike is *Restrepia antennifera* (I-C). Paddle-shaped, pointed leaves on thin stems support a succession of relatively large flowers from the juncture of stem and leaf, the most showy portion being the lateral sepals, joined in a boat-shaped body with either a yellow or white background heavily spotted with maroon. The dorsal sepal and petals are reduced to threadlike structures equipped with enlarged clublike ends reminiscent of butterfly antennae. Shade, moisture, and moderately cool temperatures will emulate the conditions of the restrepia's native Colombian Andes. This and other restrepia species may be propagated by leaf and stem cuttings, unusual among orchids.

Cool-Temperature Miniatures

For those with cool temperatures for at least most of the year, the Brazilian *Promenea xanthina* (C) will provide a wealth of proportionately large yellow flowers on a small, neat plant. The plant, too, is distinctive, with gray-green pseudobulbs and leaves, from which the single flowers emerge on short stems. Grow in medium light and with frequent watering for a specimen pot plant with many flowers.

Completing this introduction to miniature orchids are two representatives of the small but spectacular Brazilian genus *Sophronitis, S. coccinea* (C) and *S. cernua* (I-C). The former is a 2″ plant which becomes smothered with exceptionally showy 2–3″ round scarlet-orange blooms held just above the leaves. *Sophronitis coccinea* prefers moderate light and plenty of moisture in small pots, and requires coolness to do well. Less demanding is *Sophronitis cernua,* with clusters of smaller, brick red flowers. It grows at a lower elevation, and does best creeping on a mount. It should be kept rather dry and bright.

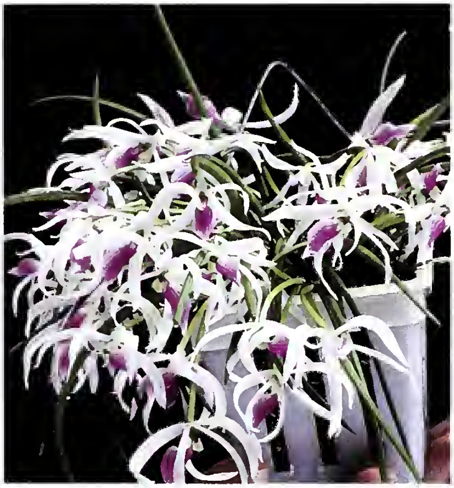
The species described above represent but a tiny fraction of the fascinating forms available in small orchids, and the challenge of assembling and successfully growing a diverse collection can be a rewarding (and consuming!) horticultural pastime. ♦

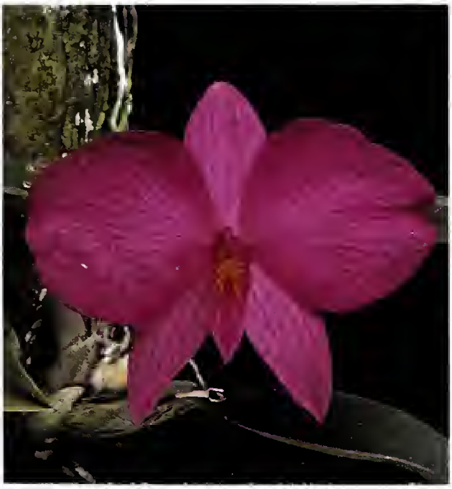
AN ORCHID GALLERY

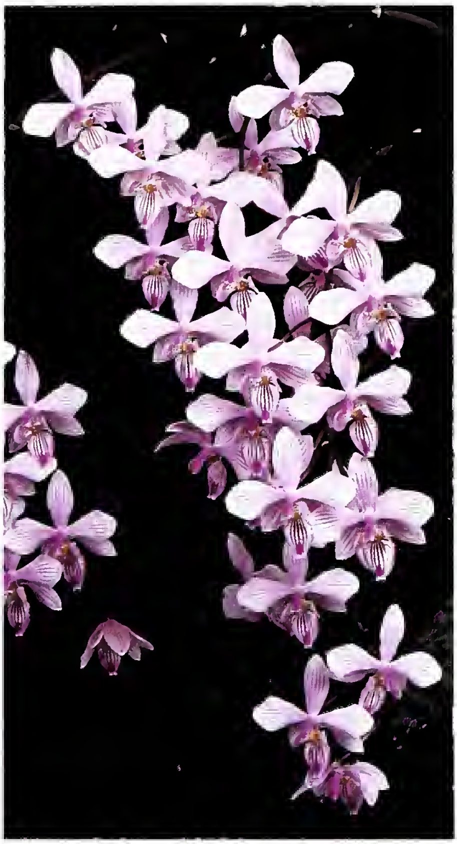
Charles Marden Fitch

Showy cattleyas, paphiopedilums, and cymbidiums are the best known orchids in temperate-climate collections but many more genera are equally suitable for the home grower. This photo gallery illustrates some of the most charming available types.

Remember that hybrids, even those primary types (between two pure species), are usually more adaptable to variations in culture and environment than species. Most hybrids are thus easier to grow than most pure species.

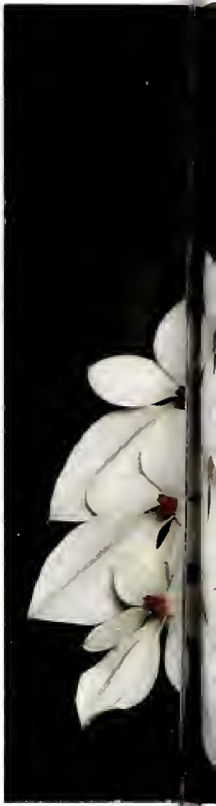






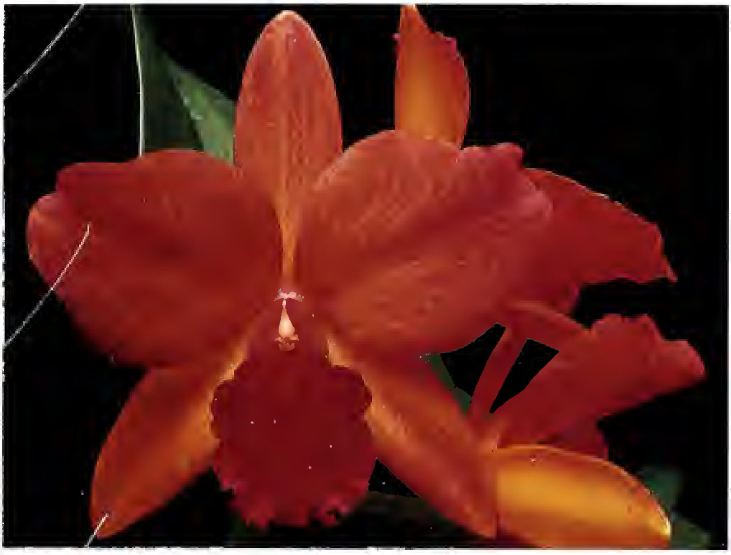
Top left, *Leptotes bicolor* 'Karen', a dwarf Brazilian species, received an Award of Cultural Merit for hobbyist J.L. Webb from the American Orchid Society. Bottom left, *Sophronitis roseum* 'J&L', AM/AOS (80 pts.) a miniature species from Brazil grown by H. Phillips Jesup. Right, *Phalaenopsis* Baguio, a compact growing hybrid of the Philippine species *Phal. schillerana* and *Phal. lindenii*.

Above, *Ascocenda* Leng grown by T. Orchids in Bangkok, Thailand, specialists in *Vanda* hybrids. *Ascocenda* is a man-made genus of *Vanda* and *Ascocentrum*. Below, a recently made primary hybrid of *Brassia caudata* x *Brassia gireoudiana* grown under fluorescent lights in a greenhouse by editor Charles Marden Fitch. The flowers are fragrant.

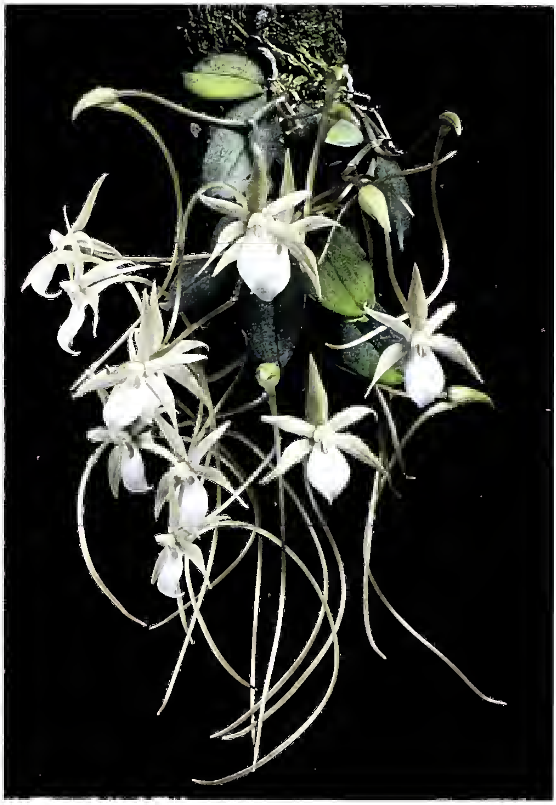


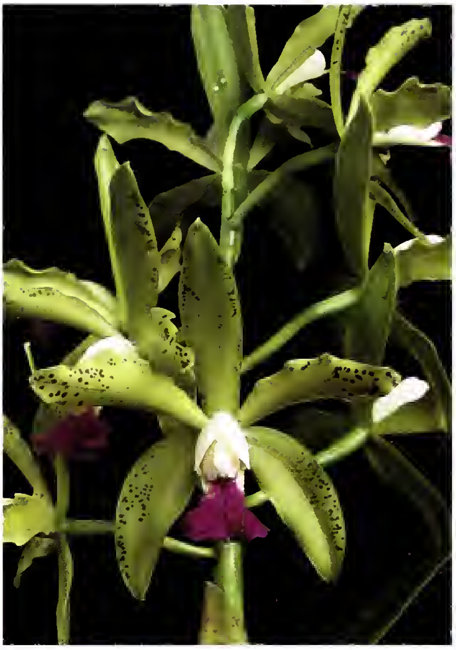
Above, *Aerangis*
tree. Below, a
genera is *Lc*. Br

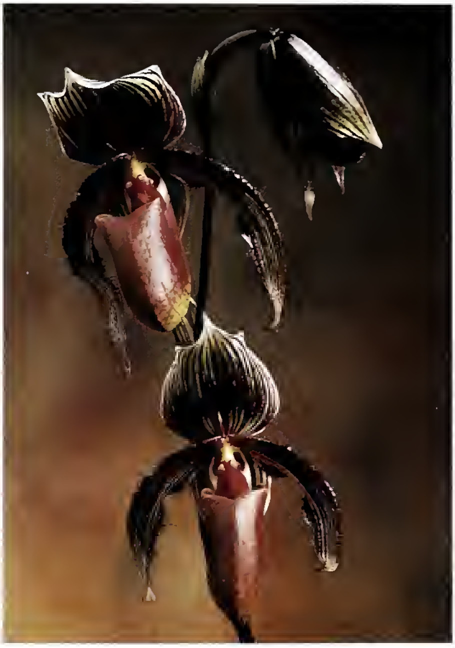
on potted coffee involving three Jewel Box.



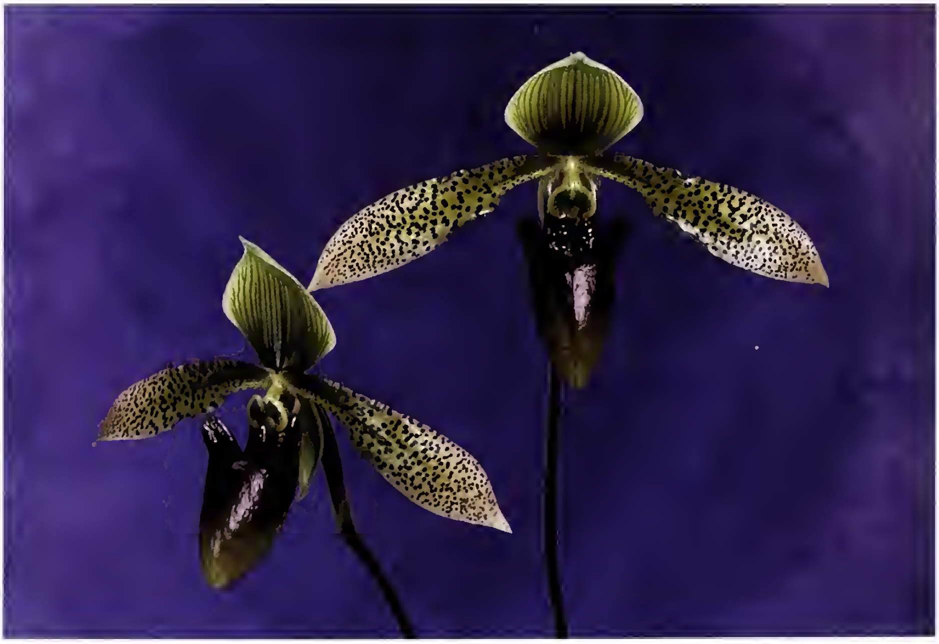
Above, *Slc.* Hazel Boyd, a compact growing cross made by hybridizer Frank Fordyce. Below, *Aerangis curnowiana* 'Marge', JC/AOS, a miniature species well grown by hobbyist Paul Gianferrara.



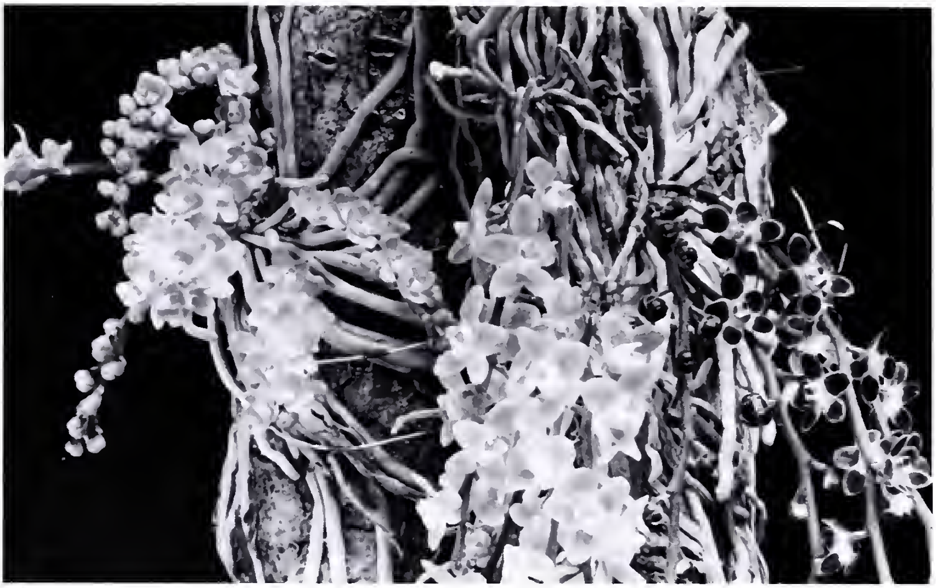




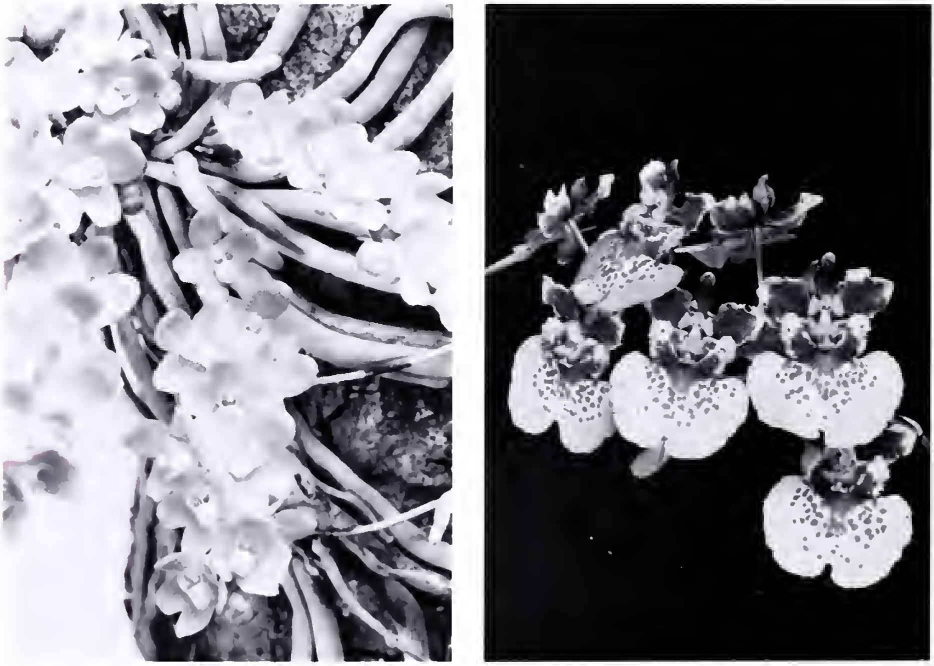
Above left, *Lc.* Adelaide Waltman 'Talisman Cove' (*C. guttata* x *Lc.* Elstead Gem). Above right, *Paphiopedilum* A. de Lairesse 'Vashon', AM/AOS (80 pts.) a primary hybrid of *Paph. curtisii* and *Paph. rothschildianum,* grown by the Beall Company orchidists. Below, *Paphiopedilum* Nisqually 'Talisman Cove' is a primary hybrid of two species from Thailand, *Paph. sukakulii* and *Paph. appletonianum.*



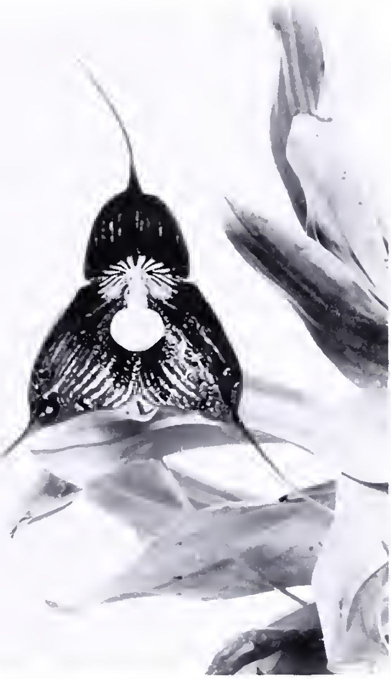
The fragrant *Cycnoches chlorochilon,* known as the swan orchid, has yellow flowers with white lip and a dark green platform.



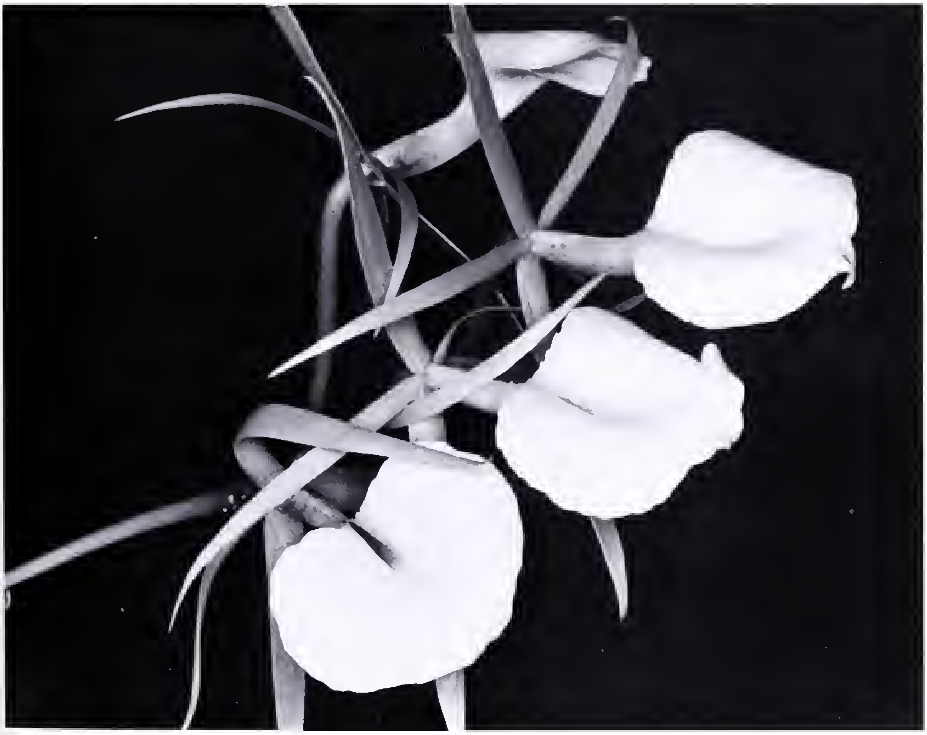
Chiloschista lunifera and *Chiloschista usneioides* (R) are leafless orchids from Southeast Asia.



Left, *Chiloschista lunifera.* Right, *Oncidium* Sunset is typical of modern succulent-leaf oncidium hybrids bred from the equitant species. The small plants thrive on hunks of cork, or similar culture.



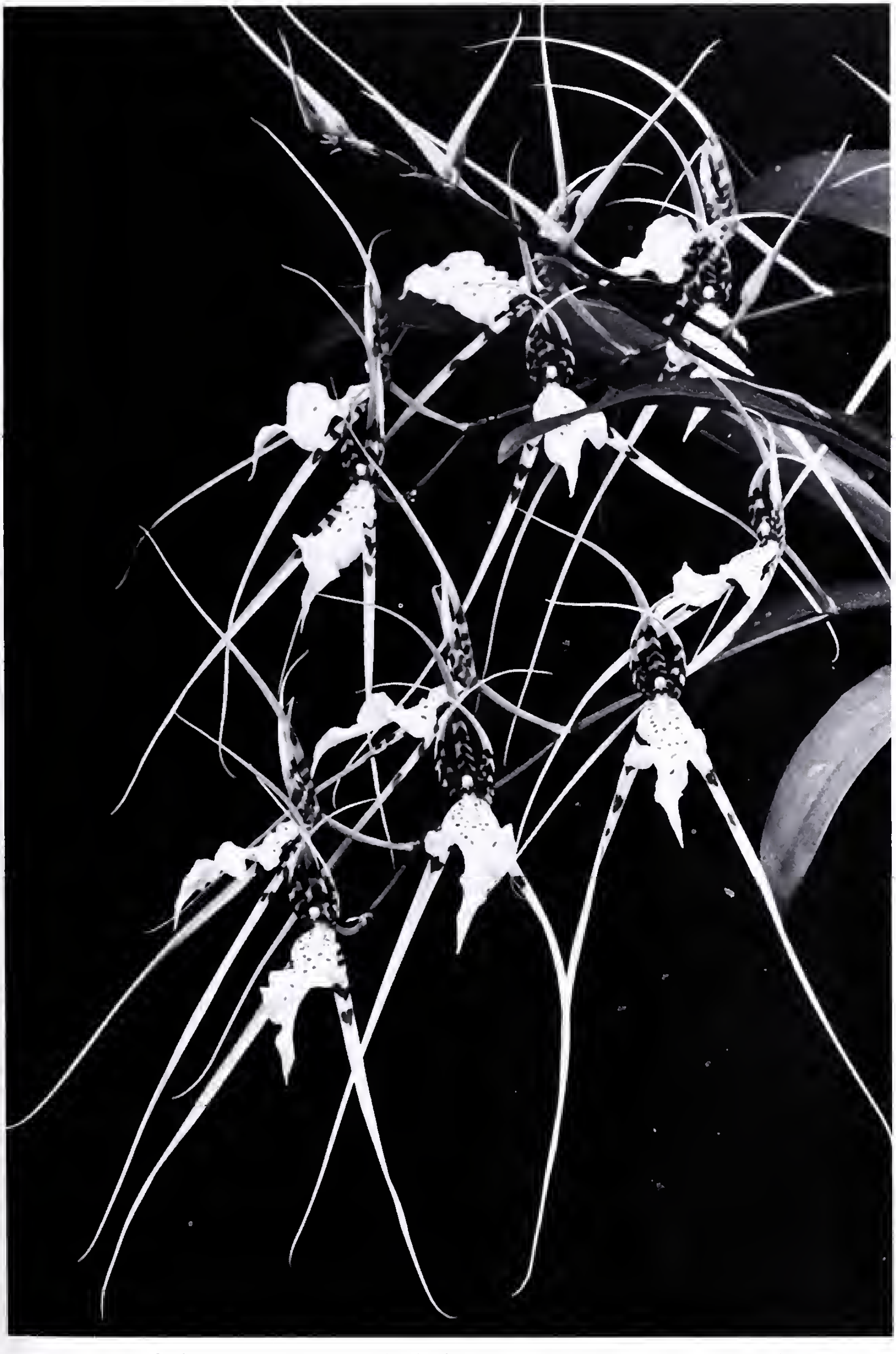
Dracula vampira is a cool-preference orchid needing high humidity. It comes from the Andes Mountains cloud forests.



Brassavola nodosa is an adaptable orchid with flowers that are very fragrant at night.

Right, *Odontocidium* Hans Neuenhaus is a modern man-made genus blending *Odontoglossum* with *Oncidium*. The resulting hybrids accept warmer conditions than pure *Odontoglossum* species. Left, *Angraecum leonis* is a dwarf species with fragrant flowers.

Vanda Jennie Hasimoto is typical of modern strap-leaf vanda hybrids often grown in regions where year-long sunshine prompts abundant flowers. Some hybrids will bloom in temperate regions if grown in a warm sunny greenhouse.



Brassia Edvah Loo is a primary hybrid of 2 Spider Orchids. The yellow and brown flowers smell like honey.

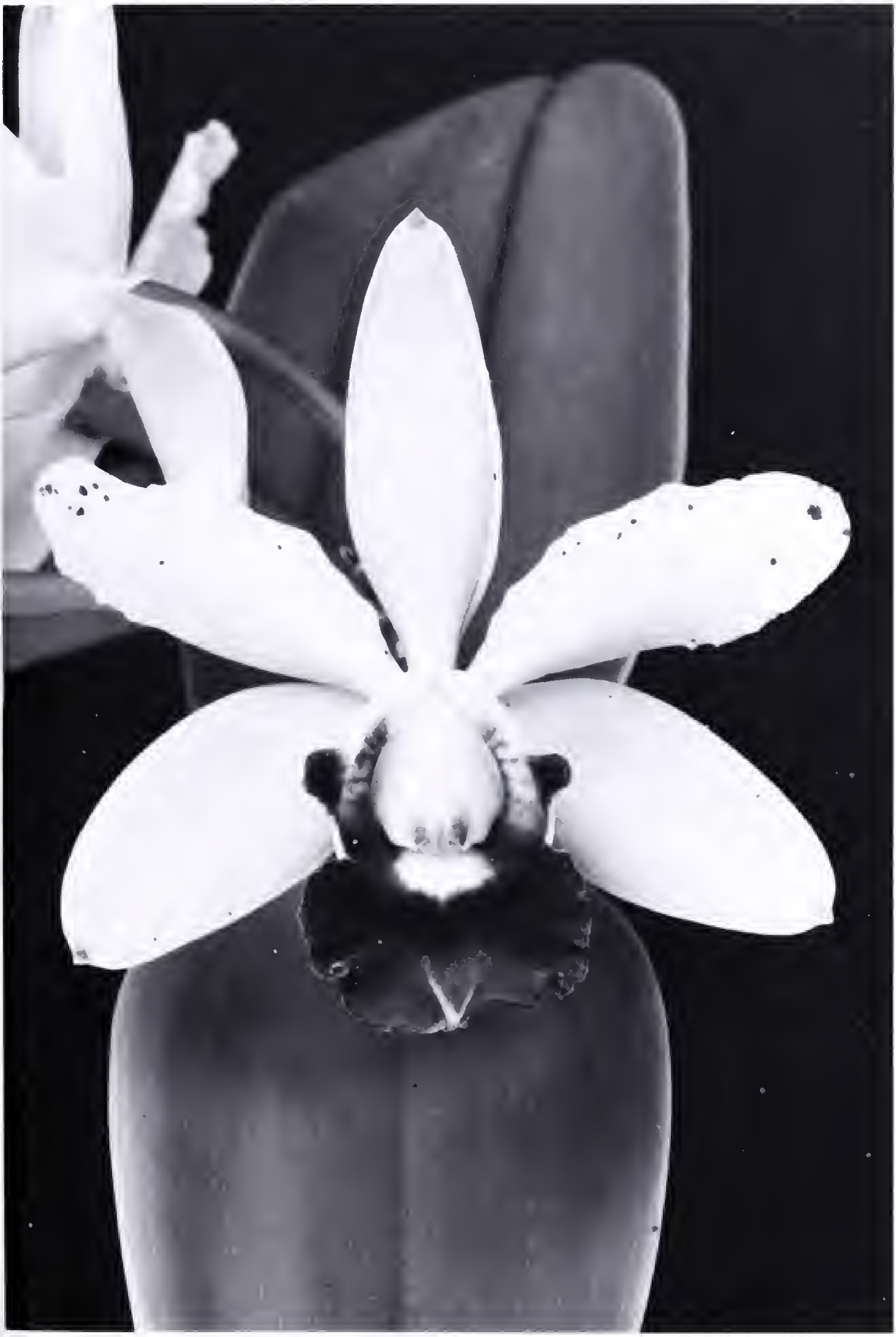
MINIATURE CATTLEYAS

Frank Fordyce

What is a miniature cattleya? Presently the major hybridizers of miniature cattleya-types have established their own guidelines of what constitutes a miniature. My guidelines, published by the *American Orchid Society Bulletin* of March 1983, allocate miniatures to three plant size groups. The micro-miniature, plants of 3–4″ in height (measuring from rhizome to average leaf height); the miniature, plants 5–10″ tall; and the compact, plants 10–12″ tall.

The micro-mini group is currently dominated by such species as the entire *Sophronitis* group, several tiny laelias such as *L. lilliputana, L. bradeii, L. lundii, L. pumila,* and others including *Epidendrum conopseum.* Few hybrids to date retain the small plant stature because, when bred with other, more full-formed flowers of the *Sophrolaeliocattleya* group, plant size is increased. *Sophronitis cernua* hybrids, in most instances, do retain small stature but are very difficult to hybridize. Certainly the micro-minis will find wide acceptance

Above, Cattleytonia Rosy Jewell 'Ewa', AM/AOS is a dwarf grower with rose-lavender flowers, 2-1/4 inches across.



Cattleya Small World 'Talisman Cove' is a dwarf growing hybrid of two species: *C. aclandiae* and *C. luteola*. Plant is 8 inches tall, has 2-1/2 inch across yellow flowers with dark purple lip.

with windowsill and "under lights" growers in apartments.

The true miniature group contains species such as *Laelia sincorana, L. milleri, L. flava, Cattleya walkeriana, C. aclandiae, Broughtonia sanguinea, Epidendrum tampense (Encyclia tampensis),* and others. Hybrids such as *Sl.* Psyche, *Slc.* Yellow Doll, *Sc.* Doris, *Slc.* Brillig, *Slc.* Ginny Champion, *Cattletonia* Keith Roth, and others are being registered monthly.

Compacts encompass the major popular hybrids, with foliage 10–12″ tall. The majority of these hybrids have more closely linked bulbs on the rhizome than the large-flowered standard cattleyas and do not outgrow the pot as rapidly. A much higher percentage of award type, full formed, brightly colored hybrids are found in the compact group. Such famous names as *Slc.* Hazel Boyd, *Slc.* Madge Fordyce, *Slc.* Sparkle Fire, *Slc.* Dixie Jewels, and *Slc.* Pixie Pearls are highly sought after by hobbyists. Generally the blooms of these round-petaled hybrids are long-lasting (some up to two months), many bloom twice a year, with a wide range of colors embracing red, orange, yellow, purple, and a few whites. Most can be grown as blooming-size adult plants in pots of 5″ diameter. For comparison, the standard, large flower type *Cattleya, Brassocattleya,* and *Laeliocattleya* adult plants are grown in 6–8″ pots with foliage 14–24″ tall.

Madge Fordyce

Sophrocattleya Batemaniana 'Clownette' (*S. coccinea* × *C. intermedia aquinii*).

Slc. Madge Fordyce 'Red Orb' is a true red flower of excellent shape on plant 6 to 8 inches tall, now available as meristem propagations.

Scores of new intergeneric hybrids of miniatures are now beginning to appear producing cattleyalike flowers on dwarf-sized plants. These are tailor-made for a grower with little space, such as New York City apartment dwellers; I've seen as many as six hundred orchid plants in in a small apartment.

Miniature cattleyas are among the most exciting new orchid trends today for the hobbyist and home grower alike. If you have ever wished you had something uniquely different to contribute to a conversation, try growing miniature cattleyas; even the most blase will stop and listen. ♉

Even the dining room isn't immune.

GROWING ORCHIDS IN A NEW YORK CITY APARTMENT

Arnie Linsman

When I tell people that I grow almost 600 orchids in a New York City apartment, they usually just stare at me in disbelief and ask, "How?" Generally my response is, "Easily." But that's not quite the truth. It is something of a challenge, but there's no doubt anyone—and I mean anyone—can grow orchids almost anywhere; getting them to bloom is an entirely different matter. By and large, those lucky folks who have greenhouses have a somewhat easier time. After all, they have almost completely controlled environments. Perhaps the one major difference in favor of the in-the-home orchidist who grows under lights is that he can provide as much daily "sunshine" as he wishes for his plants.

Starting Up

Before embarking on the highly infectious disease of growing orchids in a New York City apartment, there are certain decisions that must be made. First and foremost the grower must answer the question: Who really lives in the apartment—the person paying the rent or the plants? If you plan to lead a normal life in your apartment once you have started growing orchids, forget it. Somehow the plants can take over your life, your space, and your social activities.

Another question is, How am I going to grow—under lights, on windowsills, or a combination of both? There really is no "best" way. If you have great expanses of windows, especially those facing south, and they are not smack up against another building, windowsills may be best for you. But you don't have to despair if you have only north-facing windows. Your orchids can thrive there if you are selective in the choice of plants. However, if you're like me and want to grow all kinds of orchids, you can always supplement the north light by hanging lights above the plants in the window.

Another question—Should I believe everything I read in books about growing orchids? Yes and no. Most books on orchid culture give the apartment grower indications of a plant's natural conditions in the wild. However, most books on orchids, no matter what the title may lead you to believe, are designed for people who grow orchids at home *in a greenhouse*. And unless you are willing to turn your precious apartment rooms into a greenhouse, you really have to learn and devise methods of your own to approximate the specific native habitats of orchids.

Perhaps the most extreme case regarding growing orchids in a New York apartment is that of a man who converted the elegant living room of his posh Park Avenue co-op into what may have been the ultimate space for indoor growing, complete with huge sodium lights, a stainless steel potting sink, humidifiers, air conditioners, fans, and specially lined floors and walls. Of course it cost a fortune, but his plants garnered plenty of American Orchid Society awards because they grew and flowered so beautifully. Sad to say, this fabulous setup no longer exists; the man opted for an honest-to-goodness greenhouse and moved himself and his thousands of plants to California.

Making Adjustments

So the books can give you the basics, but the truth is that you must figure out the best way to grow your plants for your particular conditions, and that takes some time and effort. Among other things, you will suddenly find yourself becoming an amateur plumber, carpenter, and electrician.

When I first started growing orchids, I devoured the books and pored over the photos and drawings, finding most indoor orchid setups somewhat untidy, disorganized, even a bit hazardous. Being reasonably pleased with the look and style of my apartment, I vowed never to have plants all over the place with fans and lights and snaking electrical wires. My apartment, I said to myself, is my home and is going to stay attractive, comfortable, neat, and organized.

Was I mistaken.

It didn't take long for me to develop a serious case of orchid fever, and while the apartment still looks okay (just okay), it has all the ailments I had so assiduously tried to avoid.

There are, of course, ways to avoid a lot of the "appearance pitfalls." One Manhattan grower has a wall of orchids—shelves of plants with lights above. He can close off the entire growing area by drawing vertical metal shades across the wall. It's very neat and precise, just the way I wanted things to be, but frankly, my hobby just grew like Topsy, and the plants and their needs have taken over. Lest anyone think I'm sorry, I'm not!

Since I grow both on windowsills and under lights, I have different arrangements for the different areas, some of which might strike a novice or non-grower as bizarre. The fact that almost all orchids need light, air movement, controlled variable temperature, water, and humidity in various combinations can lead the home orchid grower to strange solutions. The books—including this one—all have suggestions for achieving reasonable humidity levels; the most widely used is the pebble and water tray. My windowsill pebble trays are, for the most part, dimestore plastic drawer dividers; some have pebbles in them, others not, but all are filled with water and surmounted with rubberized sink racks or plastic egg crating which hold the pots. In some windows I have a single shelf holding the trays, in others there are as many as three shelves. In almost every window (I now have plants in every room, except one bathroom), there are supplemental lights, some incandescent, some fluorescent. All are on timers, set for fourteen to sixteen hours, depending on the time of year.

In addition, there are a pair of three-shelf light cases in what once was a rather pleasant dining room. Shelves and water trays in the cases are mounted at different heights to accommodate varying plant sizes with fluorescent tubes above. And then there are the fans, all over the place, all sizes and shapes, and all operating twenty-four hours a day. In the dining room are two oscillating fans with the two light cases. The dining room window is recessed and has three shelves. A clear plastic roll-up shade can completely enclose the recessed area, providing a contained environment. In the window are two small muffin fans which are "aimed" at the window to "bounce" air movement back at the plants, rather than blow directly at them. Even during the summer months when the window is open, the fans still operate.

Off the dining room is a small bathroom which is tiled, thus providing a somewhat cooler atmosphere. Two shelves in the small bathroom window have fluorescent tubes and a fan. This area has caused more comment by visitors than any other, because for the longest time I chose not to have the constantly-flushing toilet repaired, believing that in its broken state the toilet provided additional humidity to the plants. Now it has been fixed, and I've noticed no change in the plants.

The living room windows provide almost twelve feet of sill space with a wide-open northern exposure. Plants are on water trays, with two large humidifiers below. There also is a brass rod suspended by chains from the high ceiling which provides space for hanging plants and gives a jungle-like appearance to an otherwise formal room.

Even the Kitchen

It is in the kitchen that I have had the most fun. The recessed window faces east and has two shelves of plants with an air conditioner below. On top of the refrigerator which is adjacent to the window, is a cool mist humidifier with two fans behind it. One fan is stationary, the other oscillating, gently blowing the mist over the plants, all of which are cool growing. Apparently this system works, since masdevallias bloomed profusely this summer instead of contributing to the usual hot weather funeral services for these types of plants. Of course, I must admit I do not use the oven from April to November, a drawback of sorts, I guess.

There is, in my opinion, no absolute way to grow orchids in the home. Everyone I know who grows orchids in the city has a different method or combination of methods to accommodate his or her particular growing locations. Yes, paphiopedilum and phalaenopsis are the easiest of the orchids to grow on windowsills or under lights, yet I know people who grow and bloom vandas with their very high light requirements, odontoglossums with their cool, moist night needs, noble dendrobiums with their light and temperature demands and other orchid genera that greenhouse people say cannot be grown in the home. Yes, it is hard to get a definite, large temperature drop during Manhattan's summer nights without resorting to massive shots of air conditioning (which, of course, dries the air too much), but misting and more fans can help.

Everyone has special tricks for meeting the needs of the plants. They are developed after some trial and error, and since most orchids are both hardy and smart, they tell you if they are happy or unhappy. It's then up to you.

Growing orchids in a city apartment is not difficult; it also is not an easy, passive hobby. You have to work at it. Each of my plants goes to the kitchen sink for watering on a reasonably regular schedule. That takes time, but it also allows me the opportunity to check each plant and its condition, something most greenhouse growers can't do.

Aside from teaching you patience (a virtue in itself in a non-patient city like New York) growing orchids is a relaxing and pleasurable hobby. The challenge is definitely there, and what's more, the challenge is fun; and the satisfaction of having met the challenge and earned the rewards of beautiful and exotic flowers is worth it all. ❦

Photos by L.H. Clouser

GREENHOUSE ORCHID CULTURE

Lawrence H. Clouser and Michael S. Owen

Orchids are a diverse family whose members live in many habitats. In temperate regions, a greenhouse is ideal for protecting countless species and hybrids of tropical and subtropical types that will not tolerate winter conditions. Most of these are epiphytic, meaning that in nature they grow on trees and rocks instead of in soil. Some orchids can be found near sea level and others high in the mountains. There are those that live under rainforest conditions and others in drier regions. As greenhouse orchid growers, we must choose plants that suit our conditions, or create an environment to suit the plants we choose to grow. We must meet basic cultural requirements, such as temperature, light, and humidity, and understand how they interact.

Temperature

Temperature is one of the major factors in greenhouse orchid culture. It is generally accepted among growers that tropical orchids will do well in one of three temperature ranges. They are referred to simply as cool, intermediate, and warm. Some growers choose to concentrate on groups of plants from only one temperature range; others prefer some plants from all three ranges. Even in a single greenhouse, we can often find niches or micro-climates that will enable us to grow plants from

Odontoglossum Charles is typical of *Odontoglossum* hybrids that thrive in cool greenhouses.

different ranges. The ideal situation, however, is to have definite temperature zones. It is important to note that regardless of the range, a day-to-night temperature differential must be provided, with the day temperature rising 5 to 10°F above the night temperature. This is necessary for proper flower bud formation.

In the cool section, the optimum temperature should be 50 to 55°F at night and 60 to 70°F in the day. It is often impossible and quite expensive to maintain these temperatures in the summer, but winter heating bills will be less than that of a warmer section. Many growers use some form of evaporative cooling. The efficiency of these systems is directly proportional to the relative humidity as they do not work as well when the humidity is high. Some growers use compressor-type air conditioning. This is costly and steps must be taken to compensate for humidity loss.

After considering the dilemma of cooling, many people choose to steer clear of the cool section group. Beginners first should try plants from other groups, to avoid discouragement. There are many beautiful and rewarding plants in the cool section (see the table on page 58 with examples of plants and their temperature requirements). Please note that some plants are listed as belonging to more than one section; different species in the same genus may have different requirements. Also, some plants may be on the borderline of two ranges and might tolerate either one.

The intermediate section will support the broadest range of tropical orchids and its requirements are the most easily met. Ideally, the minimum night temperature

Longwood Gardens

Cool-growing *Paphiopedilum* Inca (l and r) and *Paph.* Clementville provide long-lasting flowers for winter color in the greenhouse.

should be 60° although an occasional dip to 55° would be tolerated. Daytime temperatures should be 65 to 75°. During summer's hottest weather, these temperatures are nearly impossible to sustain. Orchids with intermediate requirements, however, will usually tolerate these extremes. Some growers still prefer to utilize evaporative cooling to lessen plant stress during this time.

The warm section, like the cool section, is a luxury to some growers. With temperature requirements of 65° night and 75 to 85° day, heating bills will, of course, be higher. If possible, the warm section should be the closest to the source of heat, shielded the most from the wind, and the best insulated of all the greenhouses.

Humidity

For optimum growth, orchids require a relative humidity of 40 to 70 percent, depending on the temperature of the greenhouse. A general rule of thumb is that the higher the temperature, the higher the humidity. Quite often, we must raise the humidity to these levels, especially on sunny, dry days. The simplest method is to wet down the walks and areas under benches and to syringe the plants. Mechanical humidifiers are available and can be connected to a water supply and a humidistat to achieve a more constant humidity level.

Care should be taken when certain climatic conditions exist. On overcast days, for example, supplemental humidity would

Examples of Plants for Various Greenhouse Temperature Ranges

Cool	Intermediate	Warm
Anguloa	Ascocenda	Angraecum
Cymbidium	Catasetum	Ascocenda
Dendrobium (Nobile types)	Cattleya	Doritis
Lycaste	Dendrobium	Phalaenopsis
Odontoglossum	Epidendrum	Vanda
Masdevallia	Oncidium	Vanilla
Miltonia	Paphiopedilum	
Paphiopedilum	Vanda	

Lc. Meri Segars is an example of cattleya type hybrids that thrive under intermediate temperatures.

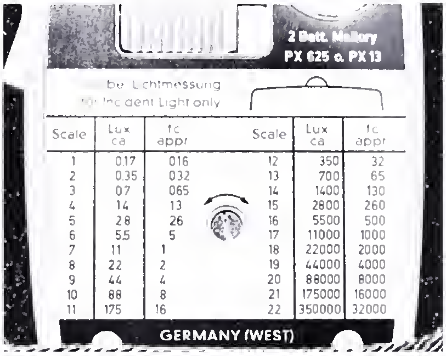
Phalaenopsis Memphis Music. *Phalaenopsis* thrive in a warm temperature range.

not be recommended because there would not be ample time for drying before night, when humidity rises naturally, and diseases can proliferate in overly-damp conditions.

Light

In their natural habitat, orchids may be found growing in a wide variety of light situations. Some epiphytes are found in treetops exposed to very high light intensity, while others grow under dense canopies with very little light passing through. A greenhouse can duplicate these conditions for a wide variety of orchids. Vandas and asconcendas, for instance, have high light intensity requirements and can be hung high in the greenhouse, close to the glass. Paphiopedilums, on the other hand, will grow and flower very well with much less light and can be grown on benches, in shadier situations under the hanging plants.

How do we know if a plant is receiving too much or too little light? With intense light the leaves will become bleached and large areas will turn brown and dry. Conversely, if a plant has a very dark green color and does not flower well, it probably is not receiving sufficient light. Ideally, orchid foliage should be light green in



2 Batt. Mallory
PX 625 o. PX 13

bei Lichtmessung
for Incident Light only

Scale	Lux ca	fc appr	Scale	Lux ca	fc appr
1	0.17	016	12	350	32
2	0.35	032	13	700	65
3	07	065	14	1400	130
4	14	13	15	2800	260
5	28	26	16	5500	500
6	55	5	17	11000	1000
7	11	1	18	22000	2000
8	22	2	19	44000	4000
9	44	4	20	88000	8000
10	88	8	21	175000	16000
11	175	16	22	350000	32000

GERMANY (WEST)

Some photographic light meters provide conversion tables so you can determine approximate footcandles in an orchid growing area. This Luna-Pro meter has such a table on the back.

Supplemental humidity can be provided by using a mechanical humidifier.

color. Consult reference material for recommendations regarding the specific light requirements for individual plants. Light intensities are generally measured in footcandles. You can purchase a relatively inexpensive light meter capable of measuring footcandles.

Most orchids will grow well and flower within a range of 1,500 to 4,000 footcandles. Outdoor light intensities can reach 10,000 footcandles on a sunny summer day and the need for shading becomes obvious, usually from mid-spring through mid-autumn. The most inexpensive shadings are liquid preparations that can be sprayed or painted onto the glass or other glazing material. An advantage with this process is the ability to regulate the amount of shade desired by the amount of material applied. It is usually necessary to manually remove this shading in the fall when natural light is less intense. Another type of shading material is woven plastic mesh which is available in various densities and rated by percentage of actual shade. Finally, there are slat shades made of wood or metal. The best application of this form employs rope and pulleys which enable the grower to raise or lower the shades as outside light conditions change.

Regardless of the shading method used, we must attempt to block out 40 percent to 60 percent of the natural summer sunlight to avoid burning orchids in the greenhouse.

Water

As orchids are very diverse, so are their water requirements. Paphiopedilums and phalaenopsis require much more water than cattleyas, although all three need to be watered regularly throughout the year. On the other hand, catasetums, calanthes, and some dendrobiums require an abundance of water for part of the year and absolutely none for the few months they are dormant. Consult reference materials or specialized growers to find out more about particular plants.

Secondly, consider the environmental factors. As temperature and light intensity rise and humidity falls, the need for water increases; the opposite is also true.

The use of tiered benches and overhead fans assures gentle air movement around all plants.

Photos courtesy of Longwood Gardens

Another factor affecting water requirements is the type of container and growing medium used. Plants in clay pots will need water more often than those in plastic. Small pots dry faster than large pots. Finer-grade mixes retain moisture longer than coarse grades. Plants growing on slabs of cork or tree fern need water more frequently than any of the above, possibly every day.

Regardless of the frequency, watering should be thorough. Be sure to soak aerial roots as well as those in the pot. Water as early as possible on bright days as this permits plants to dry off before nightfall. Extra care should be given to plants near heating pipes or ducts, or in the draft of a fan. They will dry out extremely fast.

Problems with water quality occasionally arise. Many well waters are very good for orchids and may even contain trace elements. Other well waters may contain toxic compounds such as sodium, zinc, and boron. Watch new root development for an indication of unfit water. Roots will burn and deteriorate when water is unsuitable. Standard household water softeners should be avoided since they add too much sodium to the water. In any case, seek professional analysis and advice if water purity becomes a problem.

Other Considerations

After meeting the above basic requirements, other fundamentals that may affect success or failure must be mentioned. It is important to realize that orchids do not like stagnant air. Fresh air should be brought into the greenhouse when the weather permits. Even in the winter, many growers will "crack" a vent for a few hours a day to allow some air exchange. Do not allow cold drafts directly on plants. More important than fresh air is providing gentle air movement. This can be achieved with fans. Exhaust fans help in warmer weather as they help remove heat from the greenhouse as well as provide air movement.

Repotting is eventually necessary whether to rid a plant of decomposing mix or simply to reduce it to a reasonable size. The idea of pulling a plant out of its container and cutting it up may be frightening to the novice, but it must be done. Much has been written on potting mixes, containers, and potting methods. If you have never attempted to repot an orchid, read as much as you can on the matter. A visit to another grower for a demonstration might be the most informative and reassuring means. Remember that the proper time to repot is, in most cases, after flowering and just before or as new growth develops. Many different potting medium choices exist and even though their properties differ slightly, all are easy to work with. Properties of containers vary, and watering must be adjusted accordingly. The most important factor concerning containers is complete drainage. Slab culture, where plants are attached to and grown on cork or tree fern sections, yields the best drainage but frequency of watering must be increased.

As a rule, orchids do not require a lot of fertilizer. Many epiphytic orchids receive minimal amounts of nutrients in their native habitat. How much and how often to fertilize depends largely on stage of growth. An actively growing plant should be fertilized more often than one that has completed its growth, is in flower, or is dormant. Sometimes overfertilization will cause an orchid to put on additional vegetative growth instead of flowering. When in active growth feeding a balanced soluble fertilizer at one-half recommended strength every three or four weeks will suffice. Some growers feel that a high nitrogen fertilizer should be used when plants are potted in a fir bark mix. Slow release fertilizers are also available and can be incorporated into the potting mix or used as a top dressing. A high phosphorus fertilizer may be used to encourage flowering after a plant has completed its growth cycle. This can enhance flower production and quality.

As with any form of gardening, greenhouse orchid growing takes a little time and application. The rewards are directly proportional to the investment. If you are concerned about improvement, read more! Join orchid societies and subscribe to periodicals. Visit the library or start your own. Keep good records, as they are a library in themselves. Visit botanical gardens and retail orchid dealers. With all this help, orchids are not really that hard to grow.

GROWING ORCHIDS IN THE TROPICS

Carl L. Withner

As orchid lovers soon learn, reproducing natural growing conditions in the home or greenhouse can be a tricky proposition. There seem to be orchid "weeds" that will grow and flower for all without any special care. Others couldn't be more finicky and require a set routine with great attention to detail. A knowledge of such differences and an eye for the intricacies relate to the great variety of environmental niches in nature in which these exciting plants can grow, flower, be pollinated, and produce seed for new generations.

It is amazing how well orchids can grow in cultivation; success with orchids is a testimony to their tolerance and adaptability and of the ingenuity of the growers to provide favorable growing conditions in a variety of climates. A closer look at orchid habitats around the world will give a better perspective on what we are trying to do in the temperate zone, and how we manage to grow so many kinds of orchids side-by-side.

Cultivating orchids in the tropics requires the same attention to detail as in more northern locales. The growth requirements of a given plant remain the same; it's just that they must be provided against a different background of environmental conditions from that of a usual greenhouse, windowsill, or under-light culture. The best green-thumb secret of all is to choose only plants that will grow and flower well in your specific surroundings. Temperature/humidity relationships are of para-

This tree, in a dry region of El Salvador, supports three popular species: *Epidendrum atropurpureum* in boy's hand at center, *Laelia rubescens* at left, and *Brassavola nodosa* under boy's knee. All three species do best with bright sun and slight drying between watering.

mount importance, especially in the sea-level locations where many of us live.

Habitats

In the tropics and subtropics most desirable orchids seem to originate in mountainous areas, with relatively high humidity and a 15–20° F drop in night temperature. In the American tropics most cattleyas, certain laelias, many oncidiums, and any number of miscellaneous species come from a moderate altitude, up to 3,000 or 4,000 feet. In Asian tropics we would find many dendrobiums, the green-leafed paphiopedilums, coelogynes, the blue *Vanda coerulea,* and a host of bulbophyllums, calanthes, and still other species. Days are sunny and nights are often cool and damp after the clouds settle down in the evening over the valleys and mountain tops; rainfall may be seasonal. Orchids growing under these conditions are so-called "intermediate" orchids and require a temperature of 60–65° F at night with warmer days. Humidity requirements will run from 50–70 percent.

At sea level, on the other hand, especially near the Equator and between the Tropic of Cancer and the Tropic of Capricorn, we find more sun, more heat, and more humidity, with night temperatures about equal to days and little seasonal change. Orchids growing in these locations still prefer a temperature differential, though it need not be so great. A slight cooling at night will promote flowering in plants such as phalaenopsis (the moth orchids from Southeast Asia), in the cane-type dendrobiums and their innumerable relatives, and in the tesselated-leafed paphiopedilums. Many vandas and their cousins, the arandas, renantheras, and ascocentrums, and all their various intergeneric combinations, prefer equatorial conditions, forming large showy outdoor beds of flowers so spectacular to the tourists in Hawaii, Singapore, or Bangkok. There are no particular American orchids in this "warm" category. Almost all come from Asian

Angdi Kolopaking

This tangled patch of jungle in East Java is the habitat of several terrestrial orchids, here studied by guest editor Charles Marden Fitch.

areas where they are the most common. The most prodigious of all orchids, the gramatophyllums, are Asian and may reach a height of more than 15 feet in clumps 8–10 feet or more in diameter. Some cane dendrobiums will reach 8–9 feet, and a renanthera I saw was more than 12 feet high. Cattleyas and their relatives do poorly under such conditions, though that is not sufficient reason for people not to try to grow them in the lowland tropics.

At the cool end of the spectrum, the American tropics come to the fore, particularly with odontoglossums, oncidiums, miltonias, masdevallias, the lycastes and their cousins, the anguloas. These plants are found in mountainous areas from

Vanda coerulea and Thai *Dendrobium* sp. hang from outside rafters in a hill-tribe village of Northern Thailand. The blue-flowered *Vanda coerulea* thrives with cool 50 to 60°F nights, common in the mountain habitat.

A clump of *Cattleya trianaei* thrives in a Colombian habitat of strong light, high humidity, and good air circulation.

Mexico and Central America south through the Andes growing at altitudes up to 8,000 or 9,000 feet and sometimes higher. In Asia cool orchids are best represented by the genus *Cymbidium* with many species and even more hybrids. There are also numerous dendrobiums, coelogynes, and other rare plants from areas such as the high mountains and cloud forests of Madagascar or Papua New Guinea—areas extremely rich in orchids. I'm always envious of our friends in Guatemala City, in the "Land of Eternal Spring." There the climate, at a mile or more high, is suitable for growing both intermediate and cool orchids, with few accommodations necessary to produce fine plants. The orchids usually reflect these ideal conditions by easily attaining specimen size and producing innumerable flowers compared with what can be expected in a northern greenhouse with its air circulators, evaporative coolers, and other expensive equipment providing a "natural" environment.

Tropical Travels

One is always carried away by the apparent ease with which orchids are grown in the tropics, and the temptation to bring them home alive is great. Even considering the possibility of furnishing proper greenhouse or home-growing care, we must fight down the urge to collect! True, people have brought plants home successfully in past years and grown them to perfection, but today it is more sensible to obtain locally grown plants.

Assuming that you have already made arrangements for a vehicle that can traverse tropical roads, have scouted suitable locations with a knowledgeable local collector and have provided for your safety in a variety of ways, you must still obtain that most important document, the CITES (an acronym for Convention on International Trade in Endangered Species) permit, or you will not be allowed to bring the plants into the United States.

Many orchids, as well as other plants, are on the Endangered Species List. Such plants cannot be imported into the U.S. without a CITES permit. More than thirty countries belong to this convention, and even if the country of origin does not belong, the U.S. still requires the permit. Obtaining permits is time consuming, frustrating, and often just about impossible for the ordinary traveler. All of this assumes that you have already obtained your own import permit from the U.S. Department of Agriculture before you ever start on your trip. Locally grown orchid plants look better all the time!

Also, occasionally, it is possible as an alternative to find a tropical nursery that can obtain permits and ship orchids to you by airmail. That is the most satisfactory solution for obtaining a limited number of plants, *if* there is a nursery available and *if* they are able to ship by airmail. But be prepared for the worst, as mail can be delayed in transit, USDA inspection must occur, and plants are not always in good condition on arrival. In any case, they must be re-established in cultivation. It's not with much surprise to say that locally produced plants are often a better buy!

One final word concerns the conservation of orchids. This has become a problem not only for orchids but for all the forests in the tropics—as one author says, "Extinction is forever!" Many tropical ecosystems are currently threatened, orchids included, and anything we can do to prevent these depredations is to our ultimate benefit. We are still discovering and describing new species of orchids and don't know the pollinators of many species; biochemists are just finding compounds in orchids that may be of pharmaceutical value; we still don't appreciate the complete potential of these fabulous plants or many others. Man will have interfered with or stopped evolution in the orchid family in a few short years if more and more forest systems are destroyed. It is more than frustrating to see logged, mined, or other cleared areas with countless orchids just burned up in the slash, unavailable for rescue. Population pressures seem inexorable in so many situations, and our favorite plants are being diminished, little by little, year by year. It gives us an even greater responsibility as orchid growers to keep these plants alive and in cultivation and to learn as much as we can about them in nature so that we can appreciate them in our travels for as long as we can. ◆

Catasetum seeds x 250

MODERN PROPAGATION TECHNIQUES

Charles Marden Fitch

Your orchid collection probably contains examples of several propagation techniques. Thanks to efficient laboratory procedures rare orchid species, unusual hybrids, and select clones are now sold at reasonable prices. These desirable orchids are propagated by sexual and asexual (vegetative) methods. The most recent advances in techniques involve tissue culture or meristeming, a type of vegetative propagation that produces precise duplicates of the donor clone.

Pure species are efficiently propagated by seed, preferably by crossing two select clones. Superior individual plants can be duplicated with meristem culture. These techniques bring us rare species without threatening wild populations or necessitating hazardous jungle collecting. Outstanding hybrid clones in many genera are propagated by meristem, too, providing unusually fine orchids at moderate prices.

From Seed

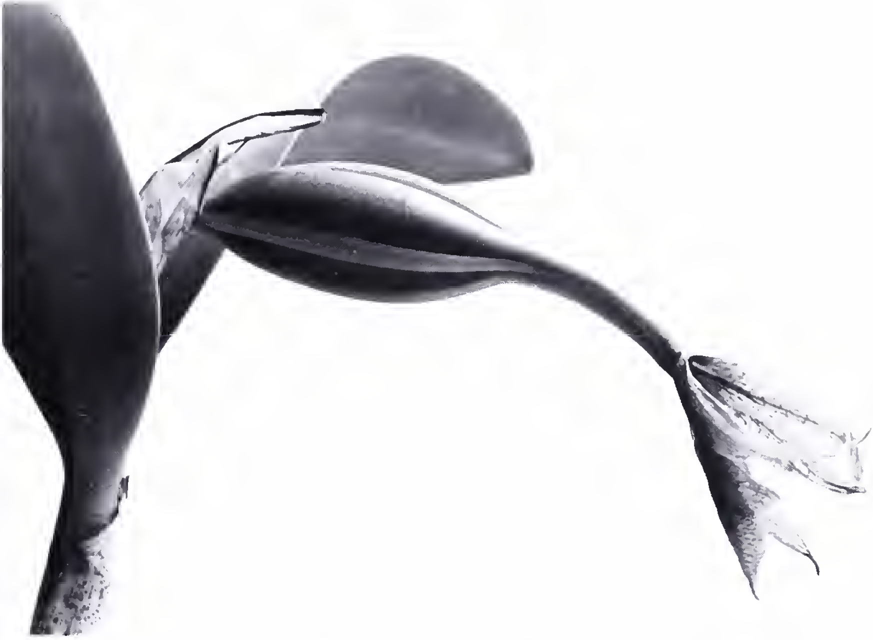
For greater variation, with the exciting prospect of flowering something superior at reasonable cost, choose seedlings of new hybrid crossings. Sowing orchid seed is a precise scientific procedure, far improved over old fashioned sprinkling of seed around the base of established potted orchids.

The expert hybridizers and lab technicians know when the fruit (pods) of different genera are most likely to yield viable seed. Picking unripe fruits for green pod sowing allows innovative hybridizers to grow unusual crosses that may not survive if fruits are left to fully mature. Growing orchids from seed is still an important procedure. Through crossing different plants, orchid breeders develop new colors, shapes, vary the season of bloom, work toward improved balance; in short, they manipulate all of the subtle characteristics that go into making a superior orchid.

Vegetative Propagation

Traditional vegetative propagation, the division of plants or waiting for offsets to form, is a slow process resulting in high prices for select divisions. Now modern tissue culture permits commercial growers to propagate thousands of identical plantlets (mericlone plants) from a single individual donor. Growing orchids by tissue culture is similar to seed sowing in that the first few years plants grow on nutrient agar (a seaweed derivative) in glass flasks.

A SHORT PHOTO SURVEY OF ORCHID PROPAGATION



Fruit on *Brassocattleya* Daffodil with developing seed inside, original flower seen at tip of the pod (right).

Seed pod of *Catasetum* contains three million seeds or more.

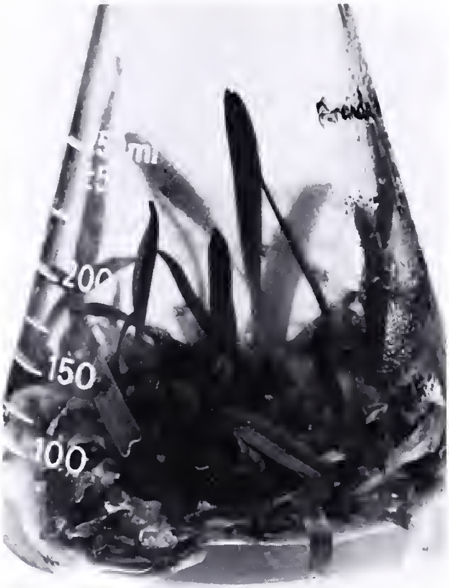
Sowing orchid seed, transplanting seedlings from flasks, and re-flasking mericlones is done under sterile conditions, usually inside a clean-air box like this. Spray bottle at right holds alcohol disinfectant.

Lab technician transplanting tissue cultured plantlets onto nutrient agar at nursery in Taiwan.

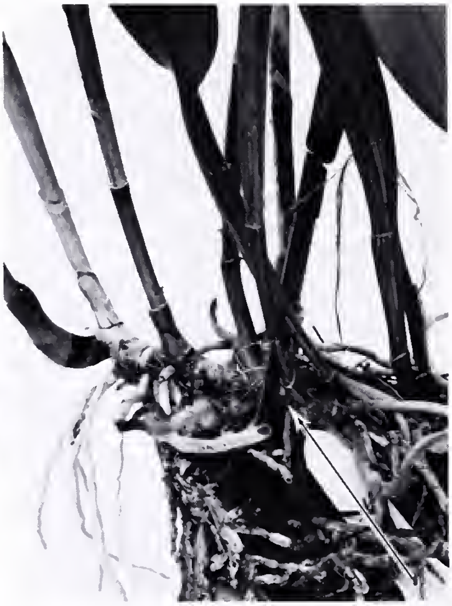
Larry Wright, Ph.D., lab director at Rod McLellan Co., inspects meristem cultures on flask rotators. Tissue cultures are rotated or vibrated (depending on genera) during the initial stages of propagation.

Separating clumps of seedlings prior to planting on new agar in larger flasks.

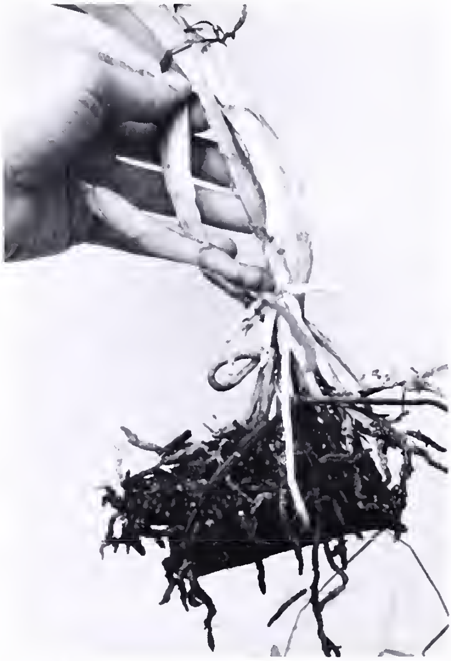
Cymbidium mericlones are washed in warm water to remove agar as plants are transplanted from flasks to community flats.



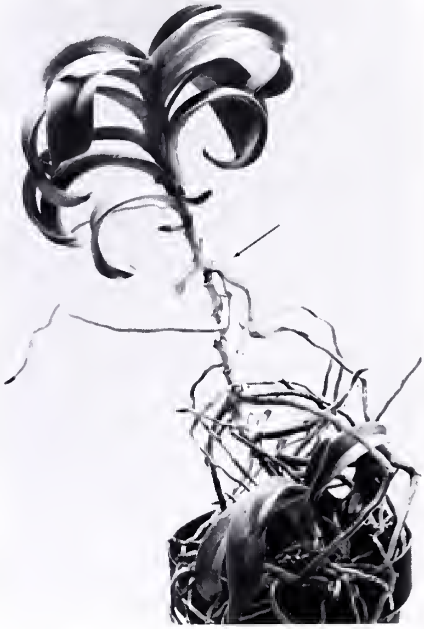
Ascocenda plantlets on nutrient agar are ready for transplanting to community pots.



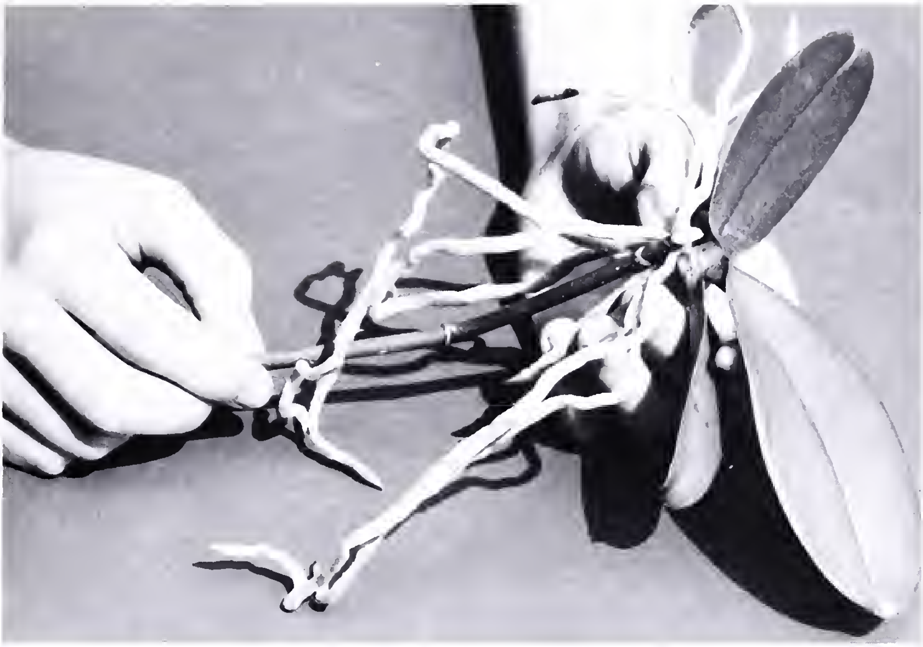
Cattleya hybrid ready for division. Arrow shows point on rhizome for clean cut to yield a division of three mature pseudobulbs with an active new growth.



Completed *Cattleya* hybrid division, new growth at left, ready for potting.



Leggy *Renanthopsis* can be cut at arrow to shorten the stem. An offshoot has already sprouted at the base of this typical monopodial orchid.



This plantlet developed on a *Phalaenopsis* inflorescence. The plantlet can now be removed and potted alone since it already has abundant roots. Hybrids with *Phal. lueddemanniana* in their background often make these offsets without extra help. Hormone paste and stem bud culture on agar are also used for *Phalaenopsis* propagation.

Paphiopedilums do best when given fresh compost every two to four years. This mature plant has been divided into two clumps, each with at least one new growth. Dead roots should be cut off with a sterilized tool.

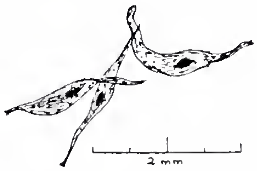
Simplified techniques have been developed recently

RAISING ORCHIDS FROM SEED

Joseph Arditti

The first description of orchid seedlings was published by the Britist botanist R.A. Salisbury in 1804, more than two thousand years after Theophrastus first described what we today consider to be an orchid plant. The variety of false notions that arose in the intervening years regarding the existence, viability and germinability of orchid seeds was undoubtedly due to their exceedingly small size and peculiar germination requirements. Most orchid seeds measure less than a millimeter in length and from less than a tenth to a quarter of a millimeter in width. (There are about 25-1/2 millimeters in an inch.)

The embryo enclosed within a membranous, but often transparent, seed coat is even smaller and may at times consist of no more than ten cells. In addition, orchid seeds have little or no food reserves and appear to be incapable of normal metabolism during the early stages of germination. Therefore, orchid seeds cannot germinate readily in nature. In order to germinate they must become infected with a fungus which somehow assists with their metabolism and may even provide certain nutrients and growth factors. This fungus eventually penetrates the orchid roots where it remains throughout the life of the plant. It is therefore known as *mycorrhiza*, meaning "root-fungus."



Lynn Maxey

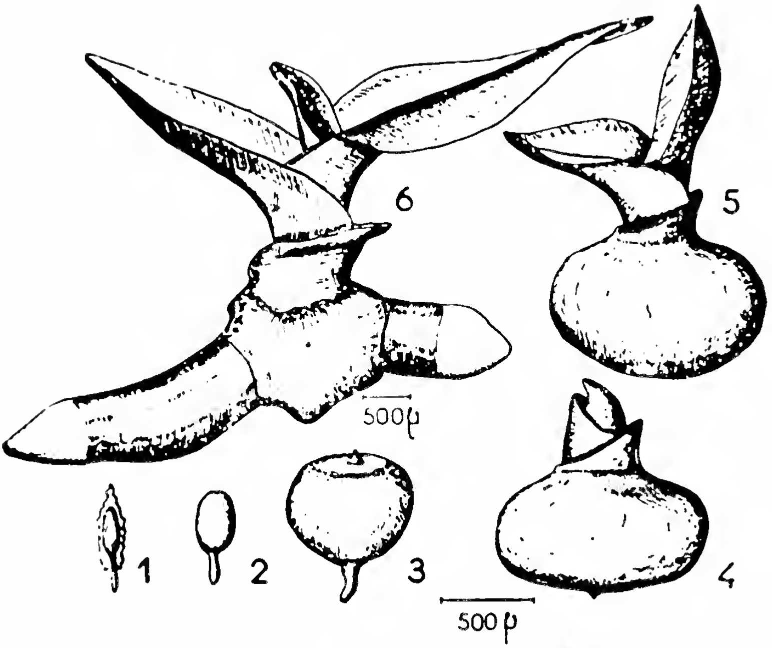
Minute seeds of a laeliocattleya orchid.

Procedures for orchid seed germination were long unknown in Europe, and for many years growers could replace their stock only through importation or vegetative propagation. However, as orchids increased in popularity during the 19th century, attempts were made to develop practical methods for seed germination and seedling culture. Apparently the first to discover that seeds sown around the base of the mother plant germinated and

E.A. Christenson

Orchid seedlings growing in a flask.

Research support by the American Orchid Society and the Orchid Digest Corporation have made the writing of this possible. I would also like to thank Lynn Maxey and Robert Knauft for their aid in the preparation of the article.



Drawings by F. Mariat of the Institut Pasteur

1. Seed swollen and green but still covered with seed coat. 2. Embryo has formed a spherule; seed coat is broken and lost. 3. Early protocorm showing pointed vegetative apex. 4. Older protocorm, discoid in shape, showing leaf tips. 5. Plantlet with two young leaves taking shape. 6. Plantlet with two or more leaves and one or more roots.

grew relatively well was a surgeon in Exeter, England named John Haris. By 1852 the Veitch nursery was using this method, as were growers in France and Ireland shortly thereafter. For half a century this was the only known method of orchid seed germination.

The biological principles which made this type of germination possible remained unknown for many years, since neither the growers nor the scientists of the day were aware of the role played by mycorrhiza in orchid seed germination. This is surprising, because the orchid mycorrhiza was apparently first noted in 1840, positively recognized by 1846, and its existence firmly established by 1886.

The part played by the fungus in germination was, however, not recognized until 1899. The French botanist Noël Bernard and German orchidologist Hans Burgeff, using this fungus, developed the symbiotic method for orchid seed germination. This involved the inoculation of culture tubes with both seeds and fungi. Although this method was a great improvement over the previous technique, germination was erratic and the fungus often killed seedlings. Still, the method was widely used since no better one was available.

The discovery which made large-scale orchid seed germination possible, and in effect revolutionized orchid culture, was made in the United States by Dr. Lewis Knudson at Cornell University. Combining his own knowledge of the influence of carbohydrates on green plants with previous discoveries by Doctors Bernard and Burgeff, Dr. Knudson reasoned that orchid seeds should germinate well on an agar medium containing a balanced mixture of minerals and sugar. He tested his theories by experimentation, proved them to be correct and developed the now famous and widely used *asymbiotic* method for seed germination. Following his original discovery, Dr. Knudson continued to investigate the problem and in 1946 published his improved and by now well known "Knudson C" medium. Although generally satisfactory for most genera and species, this medium proved not entirely suitable for *Paphiopedilum (Cypripedium)* seeds. For these a special medium known as "GD$_1$" was developed by Detert and Thomale in Germany.

Seed Germination

The asymbiotic method for orchid seed germination is relatively simple, but it requires care and close attention to details. Basically, it involves sowing the seed under completely aseptic conditions on the prescribed agar medium in a bottle or flask. This is called "flasking."* Many orchid hobbyists send their seed to professionals for flasking. When the seedlings become crowded, they are thinned by *transflasking*. When they become so large that they crowd the flask or bottle, it is time to move them to a community pot or flat. This is the point at which most people raising plants from seed acquire their orchid seedlings.

Preparing the Community Pots

A variety of methods and culture media have been employed by various growers. A simple method used successfully by Ilsley Orchids of Los Angeles is to fill a 5-inch pot with coarse fir bark or broken clay pots to within 1-1/2–2 inches from the top. This insures good drainage. Each pot is then filled to its rim with a well mixed, thoroughly moistened, firmly tamped compost consisting of the following:

seedling grade, heat treated, kiln dried fir bark	80-90% by volume
shredded redwood bark or redwood shavings	10-20% by volume
Dolomitic limestone	a full 4-inch pot per 2 cu. ft.
hoof and horn meal	the same

Removal and Preparation of Seedlings

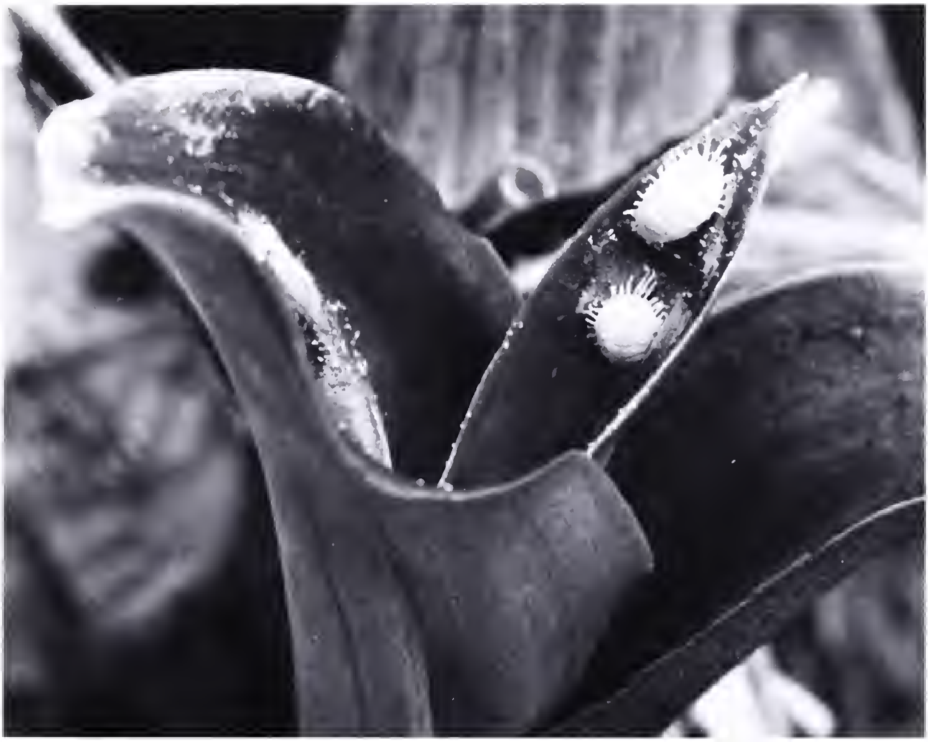
Soften the agar by placing the bottles in body-temperature water for 30–60 minutes. The seedlings can then be easily pulled out with a wire loop. If they are too big, break the bottles. Soak or wash the seedlings in lukewarm water until *all* the agar has been removed. This should be followed by a rinse in a good anti-damp agent (a fungicide) according to the instructions on the package.

Planting the Seedlings

Make a deep hole with a stick about the diameter of a pencil, carefully insert the seedling in it and firm the compost around all the roots. Allow about 1-1/2–2 square inches per seedling, and there probably will be no need to repeat until they reach 6 inches in height.

Growing the Seedlings

Place the community pots in a corner of the greenhouse where the light intensity is about 1,000 foot candles. Day temperatures should be about 75° Fahrenheit but no higher than 90°F. and the night minimum not below 70°F. Relative humidity should be around 70 percent. The young seedlings should be sprayed with a fine mist two or three times a day. Do not water them during the first week. After that, water *carefully*, since over-watering is the most common cause of failure. When young roots appear on the seedlings (usually within two to four weeks), it is time to start fertilizing. Use any of the commercial high-nitrogen soluble fertilizers, either at quarter strength once a week or 1/10 or less strength with every watering. Leach the compost every two to three weeks to prevent build-up of salts. When the seedlings become crowded, it is time to move them to separate pots. Fir bark, Mexican tree fern or Hawaiian hapuu may be used for this purpose. Pack the potting material lightly around the roots, taking care not to damage the roots. Place the pots on a greenhouse bench and treat them as adult plants. Good luck!

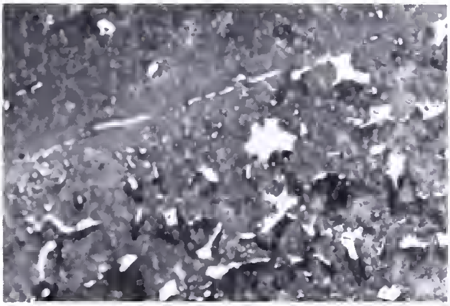


Mealybugs attack new growth of *Catasetum*.

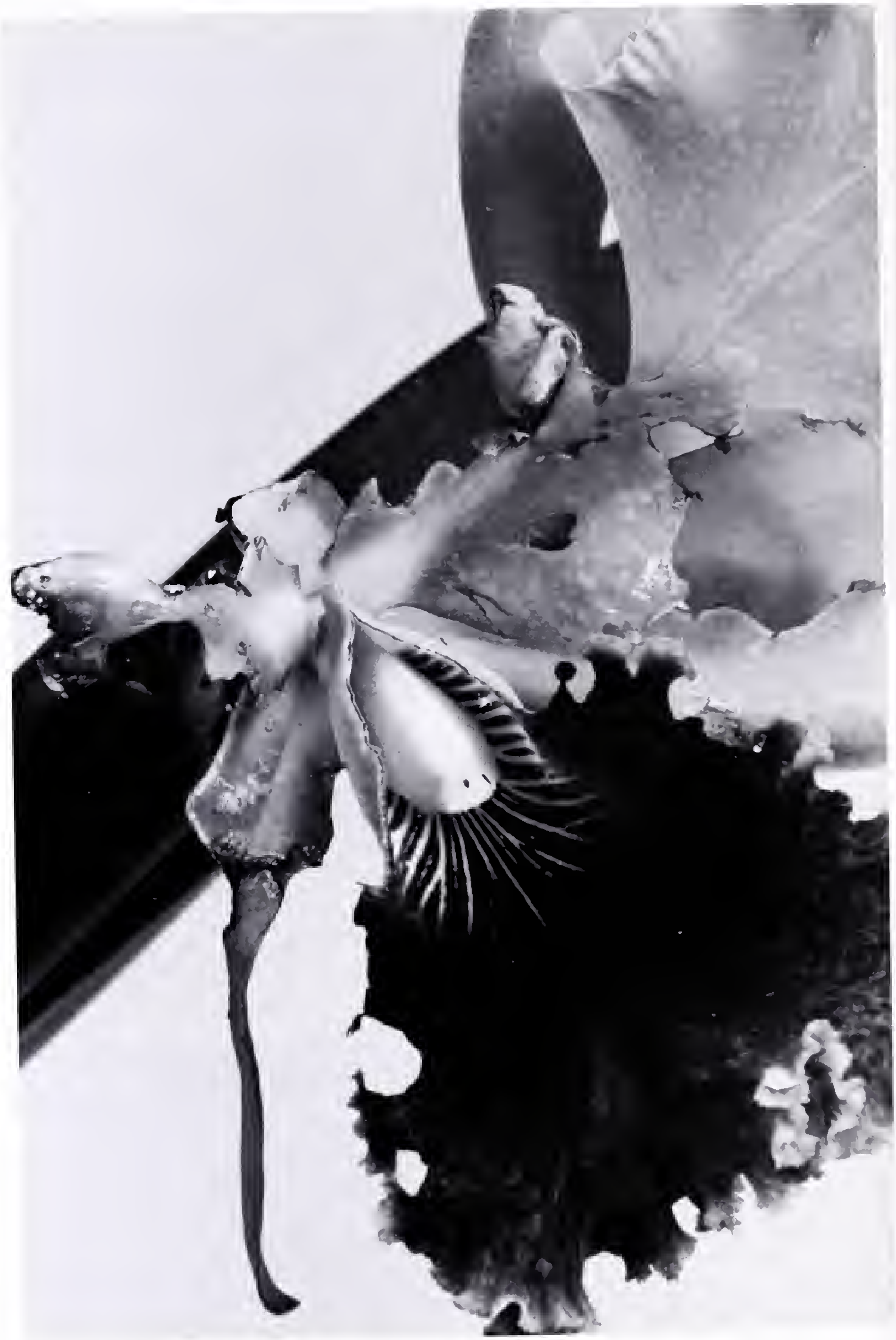
CONTROL OF COMMON ORCHID PESTS

Charles Marden Fitch

The usual array of houseplant pests infest orchids. Flower buds are favored by aphids, new growth and roots may be attacked by mealybugs, and scale insects occasionally establish on pseudobulbs. New root tips and tender sprouting inflorescences are eaten by slugs and snails. Spider-mites often gather on thin-leaved orchids but some mites damage even the thicker-leaved phalaenopsis. Beetles and weevils may invade a collection to feast on new leaves or flowers. All of these pests can become serious threats to orchid plant health unless you control them.



Opsistylis orchid leaf shows sap drops and pitting on underside after attack by mites.



Blc. flower damaged by a small slug.

Red spider mites seen at pencil point on underside of *Catasetum* leaf.

General Recommendations

1. Follow pesticide directions. Never mix sprays at concentrations stronger than suggested.

2. Wettable or soluble powders are preferable to emulsified liquid pesticides. The liquid preparations often contain an oil base carrier that may harm some orchids.

3. Apply pesticides thoroughly, but not enough to saturate the root area unless you are using a product specified as a drench for root-dwelling pests.

4. Re-apply the appropriate pesticide a second time in seven to ten days, or as recommended on the package. Most preparations kill adult pests but not the eggs.

5. Inspect newly acquired plants for pests. Isolate new plants for a month, then inspect again for pests. Placing newly acquired plants directly next to other specimens in your collection is a good way to introduce pests.

Pest Controls

Aphids: Wash off exposed insects. Spray orchids with Malathion or Orthene soluble powder (1 teaspoon per gallon of water).

Caterpillars: The biological insecticide made with *Bacillus thuringiensis* is very safe. It is available as Thuricide, Reuter Caterpillar Attack, and other brands. Soluble Orthene powder mixed one teaspoon per gallon of water is also useful.

Mealybugs: Add a few drops of wetting agent per gallon of spray to help insecticide get through waxy covering of these pests. Malathion and Orthene soluble powder are effective.

Mites: Pentac powder and Kelthane are useful miticides. Be sure to get spray on undersides of foliage.

Scale: Diazinon, Malathion, or Orthene soluble powder will kill crawling stages of scale. Add wetting agent and repeat application according to package instructions.

Snails and Slugs: Use safe solid bait

Scale insects infest an *Epidendrum* orchid.

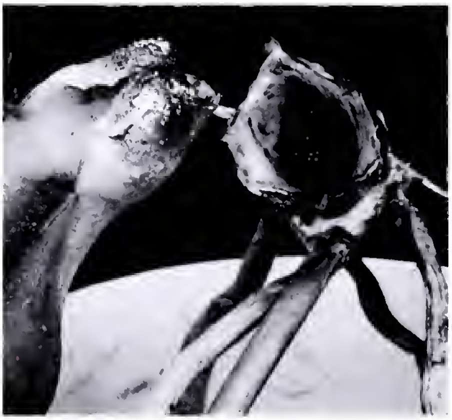
pellets around pots. Spray potting mix with metaldehyde snail/slug pesticide or sprinkle granular form on surface of potting mix.

Orchid Diseases

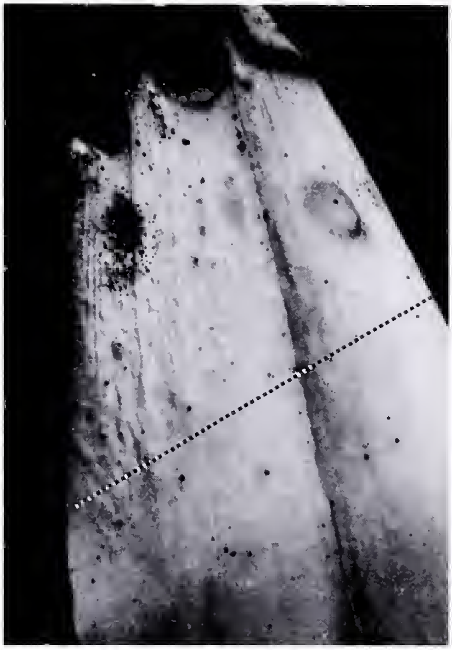
The best way to avoid orchid diseases is to be sure all plants added to your collection are disease-free. Keep your orchids healthy by controlling pests and growing the plants with adequate air circulation and light. Water early in the day so that foliage is dry by nightfall. The lower temperatures at night, coupled with darkness, encourage diseases to start if foliage is wet or water rests in new growth.

Even with careful cultivation some disease is bound to occur on a few plants. In fact some orchids are more susceptible to bacterial and fungus disease than others. With two different cattleya hybrids grown side by side one may get rot (a *Pythium* or *Phytophthora* fungus attack) while the other remains healthy. If you find that certain clones are prone to disease under the conditions you can provide, consider growing plants that are better adapted to your environment.

Fungus diseases such as black rot (*Phytophthora cactorum* and *Pythium ultimum*) and anthracnose (*Glomerella sp.*) are easy for non-specialists to confuse with bacterial diseases such as brown spot (*Pseudomonas sp.* and *Erwinia sp.*). Both fungus and bacterial diseases may occur in a collection. Fortunately some modern sprays such as Banrot, Natriphrene, and Physan help control both types of diseases.



Crown rot on mature *Phalaenopsis.*



Anthracnose leaf spot on *Oncidium lanceanum.* Treat by cutting off infected parts, then spray plant with Benlate, mixed 1 tablespoon to gallon of water.

Physan liquid, mixed 1 to 1-1/2 teaspoons per gallon of water is effective in preventing some troublesome bacterial rots that attack seedlings, especially *Phalaenopsis.* Plant pathologist and orchid disease expert, Harry C. Burnett of the Florida Department of Agriculture, recommends a spray of benomyl 50 percent wettable powder (sold as Benlate) at 1 tablespoon per gallon of water to control several common diseases such as anthracnose, leafspot, fusarium wilt, and botrytis petal blight. He also confirms that Physan is useful in preventing damp-off of seedlings just transplanted from flasks, and community-pot sized seedlings when used as a drench every two weeks (1-1/2 teaspoons of Physan per gallon of water). For many illustrations of orchid diseases see the booklet *Orchid Diseases* by Harry C. Burnett, published as Bulletin No. 10 of the Florida Department of Agriculture, a publication available in most botanical garden libraries. ♥

BENEFITS OF THE AOS AWARDS SYSTEM

Ernest Hetherington

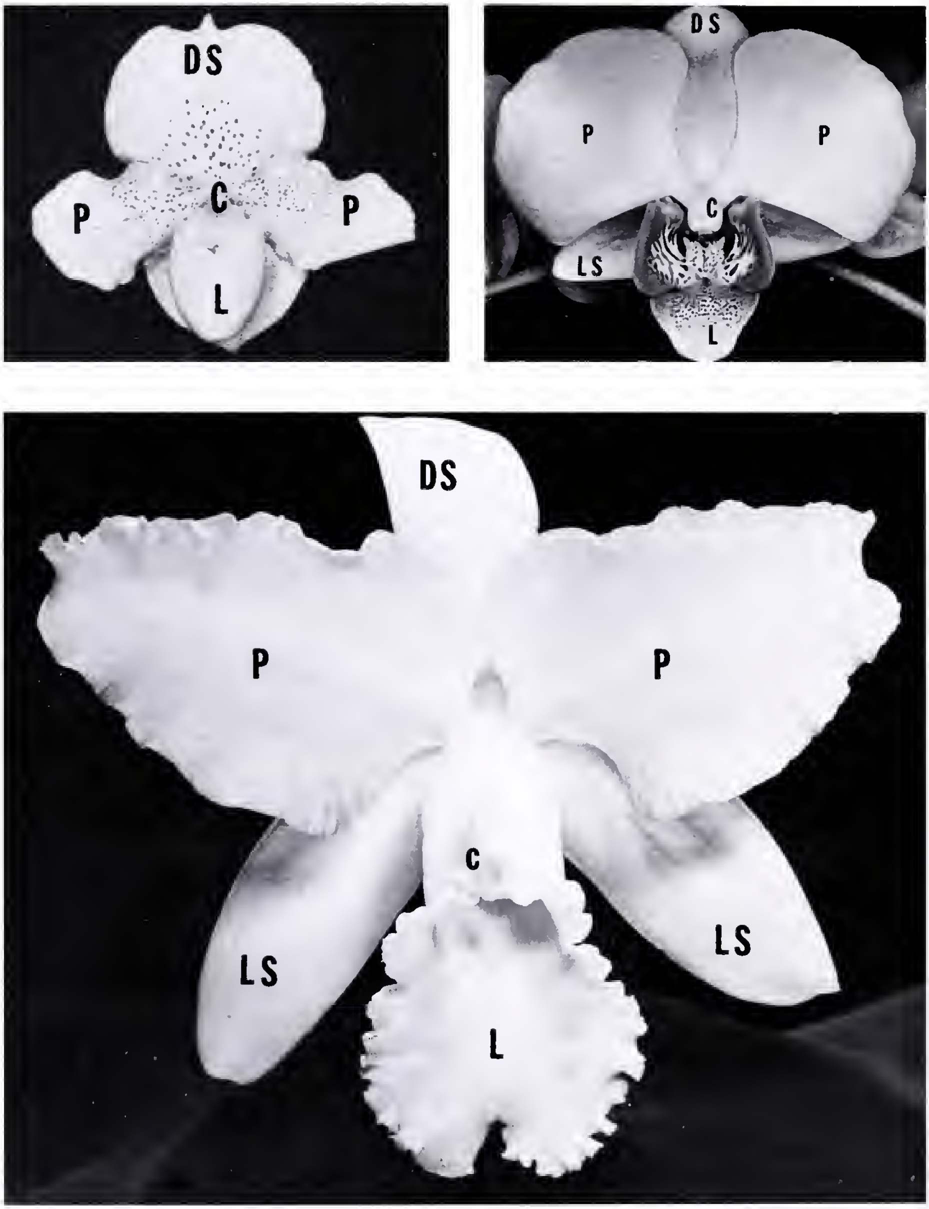
The American Orchid Society national system of awards began in the first years after World War II. Since 1945 the AOS has developed an internationally recognized system to meet the need for a fair method of evaluating orchids. The AOS Awards system is fully detailed in the AOS "Handbook on Judging." How does this awards system benefit the amateur grower?

The Judging System

Even a beginner when selecting an orchid asks, "How does this orchid, which I now have in bloom, compare in quality and other desirable characteristics with others of its type?" We could put the question another way: "How do I tell a good orchid from a bad one?" The AOS awards system helps answer these questions.

The AOS system of judging grants awards in several categories. The first category grants recognition to a superior form of an existent type. To illustrate: if you have a purple *Cattleya,* what are the qualities for perfection in that type to look for? Our second judging area is to grant recognition to new orchid hybrids that are not only new but desirably different, or an improvement. Hybridizers are continually intercrossing a great variety of dissimilar orchids. When a distinctly different orchid comes along, one that also has charm and

Detail of *Cymbidium* Leodogran 'Cradlemont' which received an Award of Merit from the AOS. This is a raspberry pink miniature cymbidium with excellent long-lasting flowers.



Above left, *Paphiopedilum* Huddle; above right, *Phalaenopsis* Linda Miller; below, *Cattleya mossiae var. wagneri.* These are three popular genera often seen at the awards judging. Major flower parts, important in flower-quality point score judging are shown as: DS = Dorsal Sepal P = Petal C = Column LS = Lateral Sepal L = Lip beauty, it is worthy of recognition. Our third category is to grant recognition to superior forms of species which have been collected from jungles around the world. If we study orchids in nature, we find that even within a given species, not all are alike. Sometimes one particular plant in a group will have flowers that are larger or darker or have certain characteristics that stand out. The Society grants recognition to these plants if shown before an AOS judging panel.

We must mention, in discussing our judging system, that there are two types of judging. Many amateurs are familiar with ribbon awards given at flower shows. These are for the first, second, or third prize at that show. The awards apply only to plants submitted at that show. The AOS system, however, is based upon evaluating that plant in bloom against all others of that basic type which the judges *may have seen;* this requires experience. It is the only fair method of granting recognition. The AOS system was patterned after judging of the Royal Horticultural Society in England which has been granting awards since 1859. Most of the orchids which are grown today are hybrids. They are the work of orchid breeders who create not only new types of orchids but who also improve existing types. The quality of our orchids is constantly improving. Even as they improve, there is no final perfection.

There are over four hundred AOS judges throughout America. A minimum of six years of training; three years as a student judge and three years as a probationary judge, are required before a person is given the title "Accredited AOS Judge." There are eighteen regional judging centers throughout the United States. The American Orchid Society Bulletin lists the location of these judging centers. These comments are intended to place emphasis on how an awards system can be of benefit to you. If there is a judging center near you, attend a session to see how orchids are judged. If you have a plant you think might be worthy of an award, take it in. There is no charge for having it judged. If it gets an award, there is a small clerical charge. When you submit the plant, you will be required to fill out an entry form. The plant is then screened by a panel of judges. If they think it should be judged, it is scored by not fewer than three judges. When we say screened, they collectively look at it. If they think it stands a chance of receiving 75 points, this is the minimum number of points required for an award, they send it to a judging panel.

What is important to you as an amateur is that when a plant receives an award from the American Orchid Society, it keeps that award forever. If it is divided into any number of divisions, every division carries the same name and the award that your plant received. This is why awards are of value to an amateur grower. If you are offered a plant or have the opportunity to buy one at a commercial nursery which has received an award, you know that it has been judged by an impartial panel and the quality of the flower has come up to certain AOS standards.

Some Criteria for Judging

In discussing the practical value of an award system, surely the question must be asked, "What do I look for in various orchids to determine their quality?" The major genera grown throughout the United States are cattleyas and allied hybrids, paphiopedilums (lady slippers), phalaenopsis, cymbidiums, oncidiums, odontoglossums, vandas, and dendrobiums.

In cattleyas, look for good flower qualities. The color must be intense, clear, and rich. The shape should be round and full with flatness and symmetry. If it is a large-flowered type, the flowers should be of good size. What is important, also, is that the flower should be carried well on a good, strong stem. Those cattleyas with small flowers must have the qualities described above except for size of flower.

Phalaenopsis have flowers of white and pink, both of which can now be expected to have large size and good rich coloring with flowers well carried on a strong stem. White phalaenopsis should have good coloration and substance so that they are not transparent. Striped or spotted phalaenopsis should have rich colors with clear, sharp markings.

In paphiopedilums look for large size, good carriage, and richness of color. The flowers (generally they have one flower to the stem) should be carried erectly on a good, strong stem. There are several basic types—the sort with spotting on the flower parts. The spotting should be clear, distinct, and bold. If it is a flower without spotting, intensity and clearness of coloring are the qualities that separate the average from the superior flower.

Millions of cymbidiums are grown throughout America, in both conventional and miniature types. Look for richness of coloring, size, shape, substance, and arrangement of flowers on the inflorescence. In miniatures, the bottom flower should clear the leaf mass and should have two or three sprays of flowers.

The AOS Awards

Let us look at some of the AOS awards so we have a better understanding of what they are. The first is known as the HCC/AOS or Highly Commended Certificate. A minimum of 75 points is required for this award. The point spread for an HCC is from 75 to 79.5. The next award in ascending order is the Award of Merit, AM/AOS. The plant must score from 80 to 89.5. This is a coveted award which is given only to plants of exceptional beauty and outstanding qualities. The next and highest award the American Orchid Society can give to an orchid, is the First Class Certificate or FCC/AOS. A score of 90 points or more is required. Very few orchids ever receive an FCC/AOS. In order to receive 90 points or higher, the orchid must be superior in so many qualities, such as brilliance of coloring, larger size flowers, and exceptionally fine shape with flowers well carried on a good strong stem.

There are other awards of which the amateur should know. One which is especially important to those who favor the species is the award known as the Certificate of Horticultural Merit. It is granted to a species orchid which is notable for its charm and beauty and which could be used for hybridizing or which has desirable qualities beyond being unusual, odd, or rare. The Certificate of Cultural Merit is, as the name implies, an award given to plants shown by an exhibitor which have been grown to special size and beauty and show excellence of culture. Basically the award is transient in that, while a particular plant which has received this award will carry the CCM on all divisions, the award is granted to that plant at the moment of its specimen culture. The division carrying the symbols of a cultural award does tell you that particular variety lends itself to specimen culture.

Of special value to those interested in finer orchids and in understanding the award system is the American Orchid Society's Awards Quarterly. This publication lists all AOS awards with illustrations. It is not only very educational and interesting but it is a wonderful "want list" to those who desire to build a collection of superior orchids of award quality.

While a system of awards is invaluable and indispensable, it must be used in conjunction with your basic appreciation of beauty. Most people who raise orchids appreciate beautiful flowers and do not need to run a plant through a series of measurements and tests to determine whether or not it is beautiful. Within us all, we have the basic ability to look at something and, within our own minds, determine whether or not we consider it beautiful. If we let ourselves be governed too much by rigidity of thinking and by what we are supposed to like or not like, it can destroy our basic appreciation of beauty.

It has been my observation that the general public, those who come into an orchid nursery and look at the flowers, are often just as capable of spotting a fine orchid or one of award potential as the best trained judge. The average person will look at a flower and give what we could call a "gut response." Very often this is quite accurate. When something like this is then submitted for judging, it goes through a more scientific and expert appraisal. This confirms for the record books the superior qualities of the plant and that the plant is worthy of an award.

While an award system definitely has its place, the majority of orchids, while not of award caliber, are beautiful.

It is also important to know that many awarded orchids are fine parents, however, many famous orchid parents have never received awards. ❦

WHY JOIN AN ORCHID SOCIETY?

Janet Howe

In the United States, if you walk into an average florist shop or nursery and ask for orchid plants, you'll possibly be shown a tiny selection of cattleyas, cymbidiums, phalaenopsis, and/or paphiopedilums at inflated prices, and receive indifferent or incorrect instructions for culture.

If you hope to grow more than two or three orchid plants on your windowsills, under lights, or in your greenhouse, membership in a local, regional, national, or international orchid society is your "Open Sesame" to the wonderful world of what has been estimated to be approximately 17,000 species of these intriguing plants (some still undiscovered). In addition to the species, there are many, many thousands of man-made hybrids with registered parentage and complex bloodlines dating back to 1852 when the first orchid hybrid was made in England.

I joined my first orchid society, the Greater New York Orchid Society (which meets every fourth Wednesday of the month at the Snuff Mill of the New York Botanical Garden in the Bronx) because I'd heard that members' own surplus plants were sold at reasonable prices, before every 8 P.M. program. Members will gather at 7 P.M. to sell and trade plants and supplies, and dues per year (1985) are still $15 (individual) or $18 per family membership (barely enough to pay for the monthly newsletter plus the coffee and Danish served at meetings).

However, for this small annual fee, one is afforded the opportunity to meet fellow orchid lovers, both amateur and professional on a one-to-one basis.

The Greater New York Orchid Society monthly meetings, like other local societies in any metropolitan area, offer cultural information by advanced growers, slide programs given by qualified speakers on many aspects of orchid growing, collecting, conserving, hybridizing, or whatever-you-always-wanted-to-know-about-orchids but didn't-know-whom-to-ask. Informal roundtable discussions on every facet of the hobby are another feature of monthly local society meetings.

Many societies hold an annual auction at which superb orchids (both donated and purchased) are offered to the highest bidders. They have a show table at every meeting and awards are given deserving plants . . . great for the ego if your plant is selected, a learning session even if it's not. Experienced growers extend their hands whenever novices encounter problems.

The American Orchid Society, with which more than four hundred local or regional societies are affiliated, is headquartered at 6000 South Olive Ave., West Palm Beach, Florida 33405. The AOS is international in scope. Meetings are held twice a year in designated cities of America.

Meetings, however, are not the main reason for joining the American Orchid Society. Its monthly publication, the *American Orchid Society Bulletin,* is. For $20 a year, members of AOS receive twelve issues of one of the biggest magazine bargains extant. It features color-illustrated articles by knowledgeable writers on every topic dear to an orchidophile's heart, notes on new orchid books, announcements of coming shows and special events, and regular departments such as Speaking Orchid-wise, the Question Box, and New Orchid Hybrids (reprinted from the English *Orchid Review*).

Interesting as these sections are, true hobbyists turn first to the ads and read the Bulletin from back to front, eager to learn what's new where.

Why join an orchid society? The answer is almost impossible to put into words because it's never exactly the same experience for any two individuals. Personally, although I was intimidated by all the talk of this mericlone and that backbulb for almost a year after I joined my first society, I'm now able to give lectures to horticultural societies and garden clubs, and as the detergent ad says, "That's an improvement."

The American Orchid Society, a group with almost 26,000 individual members, publishes the color-illustrated *AOS Bulletin,* a monthly magazine containing articles ranging from basic cultural techniques to scientific surveys of orchid genera. Other publications of the society include an Awards Quarterly reporting on all orchids receiving awards at the eighteen official AOS judging centers. Membership in the AOS includes a Bulletin subscription and a copy of the AOS orchid culture booklet. Dues (1985) are $20 per year in U.S. and $26 for foreign memberships. The AOS works with 416 affiliated societies located throughout the U.S.A. and forty foreign countries. Various AOS committees function internationally in the fields of education and research, conservation, orchid history, and awards. The AOS is a sponsor of the triennial World Orchid Conferences. Monthly AOS Judgings take place at eighteen centers spread throughout the continental U.S. and Hawaii. Schedules for the official judgings are listed in the *Bulletin.* For a free brochure covering membership benefits write to:

American Orchid Society
6000 South Olive Avenue
West Palm Beach, FL 33405

World Orchid Conferences

Every three years the international orchid community stages a World Orchid Conference. Each conference is held in a different country but always in a nation where the active local orchid societies are filled with energetic members receptive to visitors from abroad. An elaborate orchid show is the highlight of every World Orchid Conference.

The World Orchid Conference in Bangkok, Thailand offered a show featuring extraordinary specimens, here a fragrant display of *Rhynchostylis* and *Vanda,* both native to Thailand but grown around the world.

Visit a World Orchid Conference for an exciting introduction to orchid growing. Orchid experts from many countries present programs related to current research and all aspects of orchid growing. Commercial displays offer the latest hybrids and rare species grown from seed and by tissue culture. Various products useful in orchid culture are on sale.

Most conferences include a special show section devoted to art. Here orchid paintings, sculpture, ceramics, and similar representations of orchids by professional and amateur artists are exhibited, judged, and awarded. In the main show section orchid flowers, plants, and whole displays of live blooming orchids are evaluated by judging teams who award an array of cups, ribbons, plates, and plaques.

Local society members offer home visits with hobby growers, the official conference travel agents arrange side-trips to places of interest, and commercial firms welcome conference registrants with special tours through their establishments.

Future World Orchid Conference locations include Tokyo, Japan (1987) and New Zealand (1990). Recent conferences have been held in Miami, Florida (1984), Durban, South Africa (1981), and Bangkok, Thailand (1979). The World Orchid Conferences offer you an excellent opportunity to learn more about orchids on an international level. [C.M.F.]

Sources of Orchid Plants and Growing Supplies

Several large commercial orchid ranges in the United States offer good assortments of popular genera and the supplies required to grow them. Other smaller orchid nurseries, although offering mail order service, specialize in a limited number of genera or specific types of orchids such as cool growers or miniatures. Local garden supply stores offer some supplies used in growing orchids but the proper potting media for orchids are difficult to find in some regions. You may order potting media and mixtures from the large commercial nurseries listed here. Some local orchid societies accommodate members by pooling orders for growing supplies, thus saving postage. Botanical garden shops often carry small quantities of potting mix for orchids.

Listed here are a few of the larger orchid firms. For an extensive display of current orchid firm ads please consult a copy of the American Orchid Society *AOS Bulletin*. Firms listed below are experienced in mail order shipping of orchids but requesting shipment to areas below freezing during the winter increases the risk that orchids will be damaged. For the most secure shipment to states with cold winters request delivery between April and November.

Arm-Roy (Armacost and Royston)
3376 Foothill Rd.
Carpinteria, CA 93013

Jones & Scully, Inc.
18955 S.W. 168th St.
Miami, FL 33187

Orchids by Hausermann, Inc.
2N134 Addison Rd.
Villa Park, IL 60181

Rod McLellan Co.
1450 El Camino Real
South San Francisco, CA 94080

Fred A. Stewart Co.
1212 E. Las Tunas Drive
San Gabriel, CA 91778

Zuma Canyon Orchids
5949 Bonsall Drive
Malibu, CA 90265

Overseas Sources in the Tropics

Many overseas orchid sources are located in tropical countries where orchids are native. The modern trend is for commercial firms to select the best clones of indigenous species, then grow more from seed and/or meristem culture. International regulations require that all orchids entering the United States be accompanied by official CITES documents, conforming to the USA's agreement to cooperate with laws to protect endangered species. Orchids sent to the U.S. without the required documentation (Certificate of Origin and CITES papers from the country of origin) will be confiscated by the U.S. Agricultural Inspectors at port of entry. The overseas orchid growers listed below are some of the established firms that are prepared to send all CITES required documentation with their export plant shipments. Note that to import orchids from overseas you will also need a permit from the U.S. Department of Agriculture, available free from the USDA (Permit Unit, USDA, APHIS, PPQ, Federal Bldg., Rm. 368, Hyattsville MD 20782).

Green Orchids (Mr. Shat Lun Cheng)
P.O. Box 7-587, Taipei, Taiwan

Meristems of outstanding cattleyas and phalaenopsis. $5.00 color catalog.

Kabukiran Orchids (Mr. & Mrs. Javier)
P.O. Box 744
Quezon City, Philippines

Philippine species. $1.00 catalog.

Ooi Leng Sun Orchids
(Mr. Michael Ooi)
873 Sungei Dua
Butterworth, Wellesley, Malayasia

Malayasian species and their hybrids. Free catalog.

Simanis Orchids
(Mr. Atmo Kolopaking)
P.O. Box 8
Lawang, East Java, Indonesia

Indonesian species and primary hybrids. Free list.

T. Orchids
(Mr. Thonglor)
P.O. Box 21-19
Bangkok 21, Thailand

Hybrid dendrobiums and vandaceous types plus Thai species. $5.00 color catalog.

Further Reading

Culture

All About Orchids by Charles Marden Fitch. Doubleday and Co., New York. Complete guide to modern cultural techniques, hybrids, international sources of plants.

Handbook on Orchid Culture by the American Orchid Society. A booklet covering basics of orchid culture. Available from AOS.

Miniature Orchids by Rebecca Northen. Van Nostrand Reinhold Co., New York. Small-growing orchids for the home.

Orchid Culture Under Lights by Richard Peterson. Indoor Light Gardening Society of America. An illustrated 19-page paperback booklet available from the Indoor Gardening Society, 128 W. 58th St., New York, NY 10019.

The Paphiopedilum Grower's Manual by Lance A. Birk. A book written for the orchid fancier who wants to learn everything there is to know about the Lady Slipper orchids. Available from the author at 1721 Las Canoas Rd., Santa Barbara, CA 93105.

Reference

Encyclopaedia of Cultivated Orchids by Alex D. Hawkes. Faber and Faber Ltd., London. Includes some culture notes.

Orchid Biology, Reviews and Perspectives edited by Joseph Arditti. Cornell University Press, Ithaca, NY. Advanced scientific papers.

The Manual of Cultivated Orchid Species by Bechtel, Cribb, and Launet. MIT Press, Cambridge, MA. Many color photos.

The Orchids, Scientific Studies edited by Carl L. Withner. John Wiley & Sons, New York. Research papers collected, illustrated.

Handbook on Orchid Pests and Diseases. Useful paperback from The American Orchid Society. Most recent edition is available directly from the AOS office. Revised in 1985.

Glossary of Orchid Terms

The glossary presented here is in no sense comprehensive. It contains essentially those terms which the reader of the foregoing articles might find difficult or confusing. Botanical terms should not be frightening; they are exact and once a grower becomes accustomed to them, they are invaluable in discussions of one's orchids.

Award initials. The FCC/AOS, AM/AOS, etc., which may follow an orchid's name. See "Benefits of the AOS Awards System" (page 82) for explanation.

Back bulb. One of the older *pseudobulbs* on an orchid plant, suitable for use in propagation.

"Botanical." Orchid-growers' slang for all small or non-showy kinds of orchids, in contrast to the commercial corsage types of orchids. For the most part, these are grown and hybridized by hobbyists. (A better term is needed.)

Callus. An area at the base of the lip of the orchid flower that apparently is attractive to insects. Among orchid specialists it provides a diagnostic character for differentiating species.

Clone. All the plants derived by successive vegetative propagation, beginning with one original plant. In writing, the clonal name is set off in single quotation marks.

Column. The unique reproductive structure found only in the orchid family. The *stamens* are generally reduced to one or two (occasionally three are present) and are fused with the *style* and *stigma* of the *pistil.*

Community pot. Often referred to as a "compot." The single pot or other container in which orchid seedlings are planted in groups of 15 to 20 after removal from the sterile culture bottle in which they were first sown.

Corm. A solid, bulblike, fleshy base of a stem, common to many terrestrial orchid species.

Crock. Another word for potsherds—pieces of broken flower pots which are placed in the bottom of a pot for drainage.

Cultivar. A race of plants, originated and maintained in cultivation for unusual or desirable qualities and given a special name. Distinct from a species.

Deciduous. Literally, *falling off;* used of plants which drop their leaves seasonally.

Epiphyte. Literally, *on a plant;* one plant which grows upon another, but *not as a parasite.* An epiphyte merely perches on the trunk or branches of its dwelling place—usually a tree.

Grex. All the sibling plants produced by hybridizing two species, a species and a hybrid, or two different hybrids.

Hapuu. Hawaiian tree fern (*Cibotium glaucum* or *C. chamissoi*). The aerial roots, which surround the trunk in a thick, matted layer, are used as a potting medium for orchids.

Keiki. Hawaiian word meaning a child or little one, used as a name for the offshoots or plantlets that develop from the main stem or on old flower spikes of certain orchid species. After their roots have developed they may be separated from the mother plant and grown as new individuals.

Labellum. The lip of an orchid flower, formed by one of the three petals.

Lead. A new growth arising on a sympodial orchid.

Mericlone. A plant produced by "meristemming."

Meristem. As a noun, *meristem* refers to embryonic tissue, the cells of which are capable of active division. As a verb, it is orchid-growers' slang for the method of propagation by which the apical cells are removed from the tip of an orchid shoot and grown on, by continued division, as individual plants. A plant produced by this method is called a *mericlone.*

Monopodial. One of the two types of growth habits in plants. (Compare *sympodial.*) *Mono,* meaning *one,* gives a clue to the meaning of the word. Monopodial orchids have only one stem, which grows continuously from the apex, on and on. As the stem elongates and produces leaves and flowers, roots come not only from the base, but usually also from the stem itself.

Osmunda. Roots of ferns of the genus *Osmunda,* used as a potting medium.

Ovary. The part of the *pistil* that bears the bodies (ovules) which can become seeds when fertilized. In an orchid flower the ovary is situated *beneath* the sepals and petals.

Pistil. The female reproductive structure of flower, consisting of *stigma, style* and *ovary.* In an orchid flower, stigma, and style are fused with the *stamens* into a *column.*

Pollen. The male reproductive cells in a flower; in an orchid flower, borne on the *column* in a coherent mass called a *pollinium* (plural: *pollinia*).

Protocorm. The stage of growth of an orchid seedling before any leaves or roots have become differentiated. The minute embryo in the seed will have developed only into a little ball of cells.

Pseudobulb. A solid, bulbous enlargement of the lower part of the secondary stems, common among *epiphytic* orchids.

Rhizome. In general botanical parlance, a horizontal primary stem, either underground or at the soil surface. In *epiphytic orchids,* which grow on tree branches and other non-granular surfaces, there is no surrounding soil. In *sympodial* orchids, the rhizome connects successive growths, the distance between which varies in different species from a fraction of an inch to two feet.

Selfing. Pollinating a flower with its own pollen. While self-pollinating is usually avoided in the orchid family, it is sometimes desirable in cultivation to increase the number of plants in a given strain or to maintain a certain group of genetic traits.

Semi-alba. A descriptive word of commercial coinage used to designate a cattleya hybrid with white sepals, two white petals and a colored lip.

Stamen. Male reproductive organ in a flower, bearing at its tip the fertilizing cells called *pollen.* In an orchid flower, incorporated into the *column.*

Stigmatic surface. That part of the *column* of an orchid flower which receives the pollen. It corresponds to the *stigma* of flowers in other families.

Style. The stalk of the *pistil* which connects the *stigma,* at the tip, with the *ovary,* at the base. In an orchid flower, the *style* is incorporated into the *column.*

Sympodial. One of the two types of growth habits in plants. (Compare *monopodial.*) In sympodial growth, the apex of a stem does not continue growth; instead, growth is resumed by a bud below the apex (in an orchid, generally on the rhizome) which repeats the process. As a sympodial orchid puts out new growth periodically at its base, it "walks" along year after year, growth after growth.

Tepals. Sepals and petals of a flower when they are similar in form and color.

Terete leaves. Fleshy, cylindrical leaves which taper to a point. They can vary from the size of slender knitting needles to that of big cigars.

Velamen. The white, thick, spongy, absorbing and anchoring layer of cells that covers all but the growing tip of the aerial roots of orchids.

Xerophytic. Adapted to a dry environment, succulent, wax-covered leaves and fleshy stems being the usual modifications. Most epiphytic orchids show one or more such adaptations, as do cacti and other succulent plants.

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ORCHIDS

FOR THE HOME AND GREENHOUSE

1990

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COVER: A COLLECTION OF VARIOUS COMPACT ORCHIDS

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ORCHIDS FOR THE HOME AND GREENHOUSE

This handbook is a revised edition of Plants & Gardens, Vol. 41, No. 2

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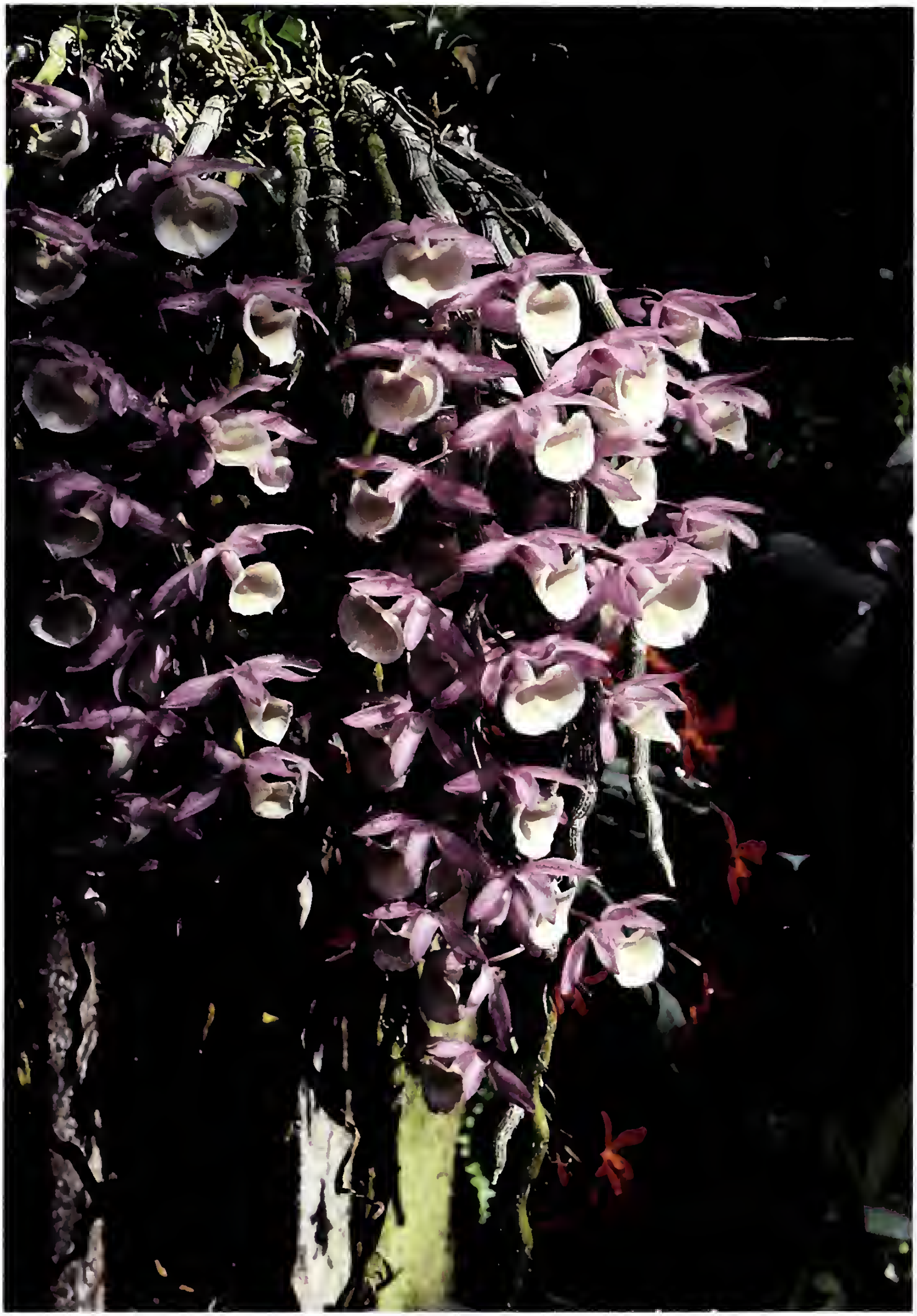

Dendrobium orchids photographed in the Longwood Gardens conservatory.

Photo by Elvin McDonal

NOTE FROM THE EDITOR

Paphiopedilum 'Transvaal'

Orchids evoke extraordinary imagery—steamy jungles, vapor-shrouded mountain slopes, tropical rain forests. Their exotic shapes, scents, colors, and textures seem unnatural, yet man is incapable of duplicating them. The fantastic array of flower forms, plant conformations, and habitats boggle the mind.

Most of us first glimpsed an orchid on the shoulder of mother or grandmother on some very special occasion. Cattleyas, the corsage orchids, have been hybridized for rounded form and clearer color just for this purpose. For many this may be the only familiar orchid.

The orchid craze began in England in the late nineteenth century. It was the titled and monied who could afford to send expeditions around the world to collect orchid plants and have them shipped back to England—and many plants perished because so little was known about their culture. But some did survive and thrive and were cultivated and hybridized in hothouses. It was not until after World War II that orchid growing hit this country.

Darwin used orchids to illustrate his theory for *On the Origin of Species*, published in 1859; three years later he published *On Various Contrivances by which Orchids are Fertilized by Insects, and on the Good Effects of Intercrossing*.

A great deal of what we know today about the unique mechanisms which make most orchids reproductivity isolated is still attributable to Darwin. There are fascinating relationships between orchid flowers and their pollinators and the adaptations that have been made by both — all of which makes the lure of orchid collecting and growing even more fascinating.

It has been a joy to work with Charles Marden Fitch, Guest Editor of this Handbook. He made time in his busy professional life to gather a world-renowned group of experts as contributors to share their expertise with you within these pages. You will find a wealth of extraordinary orchid photographs, many taken by Mr. Fitch, that are bound to whet your appetite for new purchases. Our special thanks to Mr. Fitch and to all of our contributors.

Whether a beginning orchid grower, or one who wishes to add to accumulated knowledge, we wish you happy reading and good growing.

BARBARA B. PESCH
EDITOR

WHAT IS AN ORCHID?

Carl L. Withner

How many times have people asked me if an iris isn't some kind of orchid? No. Orchids are not lilies, amaryllids, gingers, cannas, bananas or irises, but all are closely related. These families are grouped together to form the monocots of the botanical world, and the orchids are noteworthy for having the most specialized flowers, habits and life histories in the entire group.

Flower Characteristics

The major distinction of the orchid flower is the *column*, the single reproductive structure formed by a fusion of stamens and pistils that are separate in the flowers of the other families mentioned above. Though there are basically three stamens and three pistils, usually only the anther of one stamen remains functional, bearing its pollen at the tip of the column. The stigmatic surface, the part of the column that receives the pollen, is just below it.

The orchid flower has three sepals, alternating with three petals. The sepals protect the flower in the bud, but become colored and petal-like when the flower opens, often giving the impression of a six-petaled flower, or five petals plus one that is different. The different petal (and one always is) is called the *lip*. The lip petal is marked by unusual form, veining patterns and usually a series of keels and protuberances called a *callus*. The shape of the lip and its callus—sometimes the whole flower—is highly adapted for insect attraction with resulting pollination. In fact, the evolution of the orchid family closely parallels the evolution of pollinating insects.

Fruits and Seeds

If pollination takes place, a seed pod forms that may require as long as 14 months to develop. Usually about nine months will suffice, and the pod may have literally millions of seeds in it. The seeds are almost dustlike in size and are easily carried by wind and water for great distances. The embryo of the orchid seed is so tiny and underdeveloped, in comparison with other types of seed, that special conditions are necessary for its germination and growth (see the article by Joseph Arditti). Until the little ball of undifferentiated cells becomes green, forms a growing point and finally begins to develop tiny leaves, it must live in symbiotic association with a favorable fungus. It is not surprising that from the many seeds produced in a single pod only a few survive to grow to adulthood—a process that may occur in a few months but with most species takes from six to twelve years.

Orchid Evolution

Orchids most likely originated in the warm regions of southeastern Asia and

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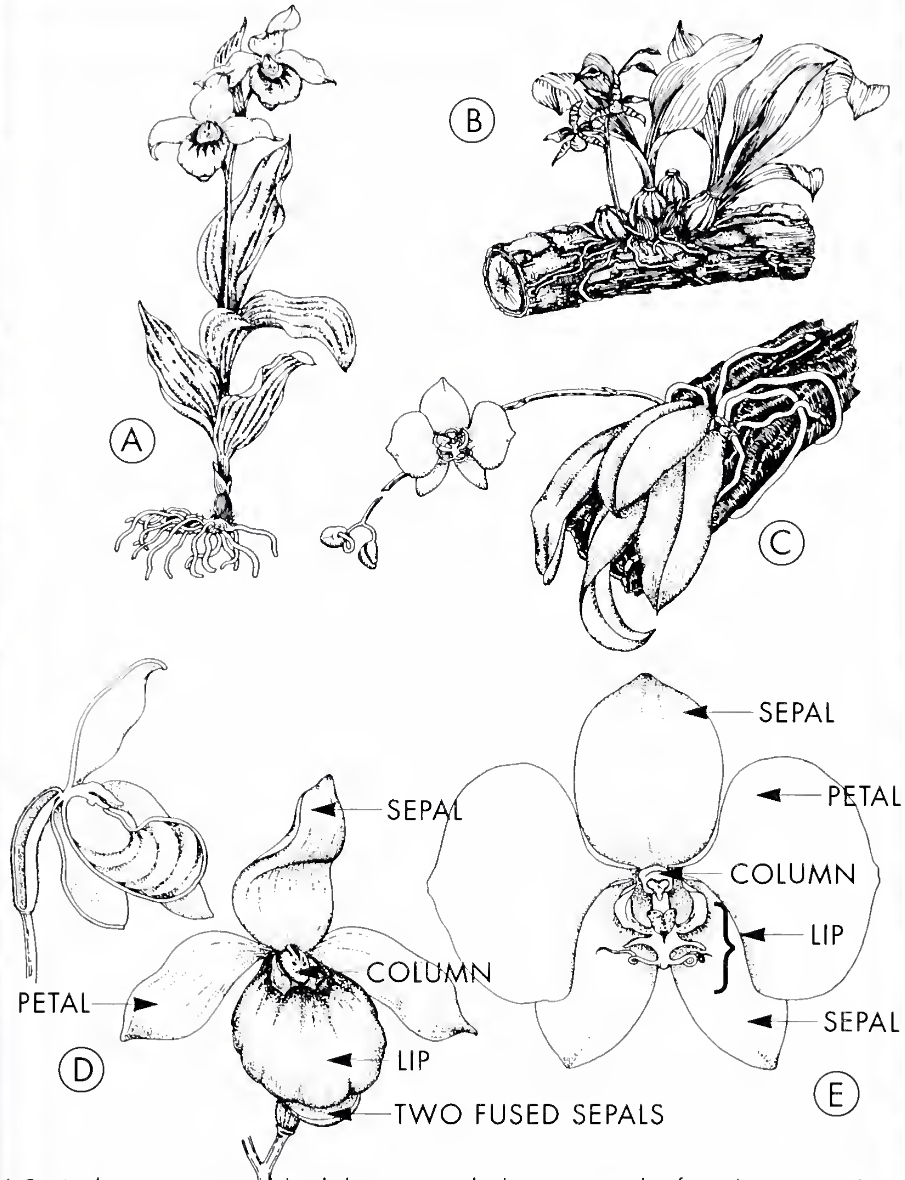
Carl L. Withner, Ph.D., *orchid grower and retired Professor of Biology from Brooklyn College, has traveled, lectured, and judged throughout the orchid world and has written articles for various magazines and books.*



A. *Cypripedium reginae*, terrestrial orchid.
B. *Rossioglossum grande* (*Odontoglossum grande*), epiphytic orchid. Plant consists of a short rhizome from which arise oval-shaped pseudo-bulbs.
C. *Phalaenopsis amabilis*, epiphytic orchid, with short stem and adventitious roots.
D. Whole and half flower of *Cypripedium reginae*. The lowermost petal is formed into a lip which here is slipper-shaped. Unusual in that the two lower sepals are joined to form one unit.
E. Flower of *Phalaenopsis amabilis*. The lip or modified third petal is three-lobed, the two side lobes being erect and the middle lobe cross-shaped with two threadlike appendages on the middle lobe.

Illustrations: Stephen K-M. Tim

spread from there throughout the world. While the majority remained in the tropics, others, in migrating, became adapted to colder climates by means of seasonal growth that responds to changes in temperature. In the tropics, some orchids can grow more or less continuously, but most are seasonal there, too, responding not to winter *vs.* summer, but to the effects of alternating wet and dry periods. Such factors must be considered in the culture of these plants.

Growth Patterns

The orchid plant itself has a variety of forms that merge into three basic patterns, one terrestrial, the other two epiphytic (*epi* = upon; *phyton* = plant). Terrestrial orchids in both tropical and temperate zones form leaves and flower stalks from underground corms and rhizomes that enable the plant to winter over. In fact, the name orchid is from the Greek *orchis*, meaning testis, in reference to the appearance of these underground parts. Theophrastus, Dioscorides, and other ancients of Europe and Asia Minor were the first to describe such orchids. In those days people were interested in the presumed medicinal uses of plants and whether or not they had souls, and thought that the shape or structure of a plant "told" what it was good for.

In the tropics, the habit of most orchids is to perch on the branches of trees, or sometimes rocks, from which they derive support but nothing else—they are *not* parasites. If the orchid grows constantly from the tip, and propagates itself by forming offshoots (known as "keikis" from their Hawaiian name) from the base of the plant, we refer to the growth pattern as *monopodial* (single-footed). Monopodial orchids are found especially in the forests of southeastern Asia, the Philippines, Madagascar (Malagasy) and Africa. If the plants grow seasonally, responding to wet and dry periods, sending up a new branch each season from the main rhizome, they are considered *sympodial* (with feet). Such orchids are found especially in the New World, but also where the monopodial types grow.

Learning to grow orchids in cultivation and to recognize the different sorts are among the intellectual challenges constantly presented by these plants. No other family involves so many aspects of horticultural activity, from laboratory to greenhouse or garden. No other family can present some 30,000 species and some 75,000 hybrids for the grower to choose from. To anyone who becomes attached to them, orchids soon become much more than botanical curiosities — they are likely to become a way of life.

Ascocenda Sunin 'Talisman Cove'

Cymbidium Tigertail 'Talisman Cove'

A HISTORY OF GROWING TROPICAL ORCHIDS

ERNEST HETHERINGTON

There is reason for us to be surprised and, of course, delighted to read an account on orchid growing by a housewife and mother of five young children living right in the heart of New York City. What is surprising is that Mrs. J. Norman Henry wrote of her experience in "Garden Magazine" of New York in July 1924—over sixty years ago! She must have been a remarkable woman. Everyone told her that the small six by seven foot greenhouse she built would not work. However, Mrs. Henry read up on the subject of orchid growing and was successful.

I quote, "A little greenhouse does not necessarily absorb much time, a few minutes several times a day and an hour or two several times a year at potting time, is

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ERNEST HETHERINGTON, *President of Stewart's Orchids in San Gabriel, California, is an accredited American Orchid Society judge, past President of the Orchid Digest and Cymbidium Society of America, and chairman of the Historical Committee of the AOS.*

all that it requires. It means also to me that my greatest pleasure is right at my door ready to enjoy at any hour of the day I have a little extra time to spare. That is a great deal, for I have five young children and could ill-afford a luxury that kept me away from them." We further quote Mrs. Henry who said she had been raising orchids for some years prior to her article in 1924, "These first orchids of mine seemed the most beautiful things I had ever seen, and all had the typical fragrance."

It is interesting to note that as far back as five hundred years before the birth of Christ, the Chinese raised certain miniature cymbidiums especially for their fragrance. We shall not go into the history of orchid raising in China. It was really in England and Europe that the marvelous assortment of orchid species such as we know today were first introduced and grown. Vanilla, which is an orchid, was first discovered by Cortez in 1519 during his conquest of Mexico. Plants of vanilla were not cultivated in England, however, until 1739 when some cuttings were sent to England from Mexico by Robert Miller.

The building of the foundation for this modern era extends back well over one hundred years. While there were a number of growers in these early years, they never have come close to the number of growers we have today. Still, it was a different era and the enthusiasm for orchid growing among the wealthy was no less than the beginner with stars in his or her eyes today. Until World War II, England was the homeland of orchid growing in the sense that we know it today. During the devastating years of the war, however, growing orchids commercially in England and Europe was difficult, if not impossible. In Europe, many of the greenhouses were destroyed by bombing. Fuel was difficult to obtain and even if obtainable, the governments decreed that vegetables should be raised in the greenhouses for the war effort rather than orchids. For this reason, during these years many of the finest orchid collections were sent to America and with them came the interest in orchid growing and the development of America as the center of world orchid growing as we know it today.

We make these comments to gain perspective, for now we must go back to England and Europe and tell a few stories of how orchid growing was developed in these countries. About 1812, some plants of vandas, aerides, and dendrobiums were sent to England from India. At that time, England was the predominant world power and had contacts in all the countries of the world, especially the tropical countries. In 1810, a company known as Conrad Loddiges and Sons began cultivating orchid plants at their nursery in Hackney, England, signaling the beginning of commercial orchid cultivation in that country. Thousands of species were to be introduced and often killed in the greenhouses of England in the years to follow. We say "killed," for as these rare, beautiful, and exotic tropical plants were introduced in their greenhouses, the owners had to learn how to grow them. There was much trial and error.

A Sensational Cattleya

The first blooming of one remarkable new orchid, *Cattleya labiata*, was the most significant event that occurred in the early days of orchid collecting because it developed orchid enthusiasm. This species is a large-flowered purple orchid with a darker purple lip; we all know it today as the purple cattleya. The flowering, we shall call it the "event," occurred in 1818. The plants had been sent to England as packing material by a botanical collector in Brazil. He did not know what they were, neither did those who received the plants in England. William Cattley, of Barnet, England, received some of these strange looking plants with straplike leaves, potted them up and found that they were growing for him. They flowered and the orchid world was never to be the same.

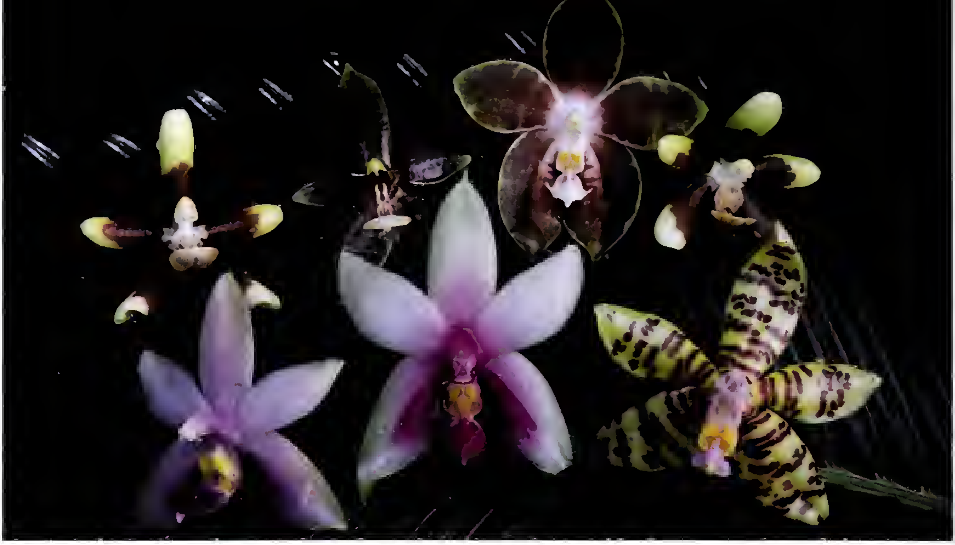
Cattley showed these blooming plants and they were recognized as something new and beautiful in the orchid world. Dr. John Lindley recognized the plants as a new type of orchid and, indeed, a new genus. He described it in the botanical journals and named it Cattleya in Mr. Cattley's honor. Because the purple flower had a large modified petal, which we call a lip, he gave it the name *Cattleya labiata* or the cattleya with the large lip. More plants of this beautiful orchid were sought but they were not discovered in their native habitat for many years. While searching, however, the botanical collectors discovered many other types of cattleyas similar to *C. labiata*. Some of these were *C. mossiae, C. mendelii, C. trianae,* and others. In time, various general nurserymen discovered the beauty of orchids and in particular the flamboyant cattleyas. They decided to establish orchid departments and engage in hybridizing or intercrossing these various exotic and beautiful new orchids that were quickly gaining popularity.

A Duke's Collection

During these early years, orchids were surely not everyman's plant. Through the expanding collection of tropical plants of the Royal Horticulture Society, orchids became more popular and were cultivated by the wealthy. If we search for the spark, the real credit for the enthusiasm for growing orchids in England must be given to the sixth Duke of Devonshire, William Spencer Cavendish. He made the growing of orchids as a hobby fashionable. Cavendish saw a plant of *Oncidium papilio* on display at one of the horticultural exhibitions in 1833 and was delighted with the remarkable character and singular charm of this species. The Duke began a collection of orchids at Chatsworth and one of his acquisitions was a white Philippine phalaenopsis which he purchased for 100 guineas, which by today's standards, conceivably could be worth $1,000 or more.

The Duke constantly expanded his collection and sent explorers to the jungles of the world to collect orchids for him. Within ten years, he had the largest private collection of orchids in existence. For many years, as the interest in orchids and the demand for them increased in England, the only plants available were species imported from the jungles of the tropics. As the interest developed also, a number of commercial orchid firms were established in England and Europe which were to become famous. Some of the most exciting stories about orchids were to be told by the early plant explorers who risked their lives going into the mountains and jungles of the tropics both in the New World and the Asiatic countries to bring something new and beautiful to the greenhouses of England. They were professional orchid hunters in the main, employed by the various orchid nurseries. Some had orchids named after them in time such as Parish, Hartweg, Wallis, and Bateman.

The mania for orchid plants in England caused prices of all available new plants to climb rapidly during these years. Auctions were held in Liverpool and London for which $200 was not unusual for a single plant. Some of the rarest specimens, which had been brought in for the auction from the jungles, commanded prices as high as $3,500 to $5,000 at today's values. Famous hobbyists, desiring their names to be perpetuated in botanical nomenclature, bid freely against one another in the hopes of introducing, through their



Phalenopsis violacea, *P. fasciata*, *P. fuscata*, *P. cornu-cervi* and *P. psilantha* are very satisfactory for home growing.

Cattleya Little Bit. Cattleyas have been crossed and hybridized to create many new orchids.

purchase, new species that might be endowed with the new owner's name. It should be added that in the days of the last century, before prohibitive income taxes, there were many wealthy landowners, merchants, and businessmen who could pay almost any price for what they desired and go to any expense to build ranges of glasshouses to house their expanding orchid collections.

One of the most famous orchid growers of all time was H.G. Alexander of

Oncidium Golden Sunset is typical of modern succulent-leaved oncidium hybrids. The plants are generally small and don't require much space.

Westonbirt, England—grower for Sir George Holford. Sir George was a very wealthy man who lived and moved in Court circles. Often he would bring various members of the royal family to see his orchid collection. We read that the orchid displays and the flowers in cut flower displays were changed twice a day in Sir George Holford's mansion. Another collector of note in these early days was Sir Jeremiah Colman of Gatton Park, England. Sir Jeremiah was the Colman of mustard fame. He was quoted as saying, "The money I made was the mustard people left on their plates." "The Orchid World," a magazine devoted to orchids published for some years prior to World War I, carried an interesting story on Sir Jeremiah Colman and his activities. What is of a special interest, however, is a picture of the grand hall of his home which was truly a marble palace of a magnificence such as we can scarcely visualize today.

We ask, "Why have orchids captured the interest of the public almost as soon as the first orchids were brought in from the tropics nearly two hundred years ago?" Perhaps our first answer must be that there is more variety in the orchid family by far than in any other family of plants. The orchids we have come to know are of an endless variety of colors, sizes, shapes, fragrances, and growth habits. Even in the temperate areas of the world, millions of people know orchids from the thousands of species growing wild in the woodlands. We can say they have had their introduction if only to appreciate the lady's-slippers of the northern woods. Even these are remarkable for their distinctive beauty.

The Royal Horticultural Society in England did much to further interest in orchids. At the various shows, private and commercial growers displayed their wares. Even today, the shows cannot be surpassed for number of plants and massiveness of displays. There is an account of a large horticultural exhibition in 1912 in which H.G. Alexander spent months preparing his display.

Propagation—A Serious Challenge

For most of the years orchids were grown, propagation was a serious problem. The tiny dustlike seed was often sown on the surface of the orchid potting mix or on a piece of turkish toweling stretched over wet brick. As the tiny seedlings germinated, they would be picked off and planted. One of the great milestones of orchid history was in 1992 when Dr. Louis Knudsen showed how these tiny orchid seeds could be germinated in flasks of sterile media if nutrients were provided. Here was a means whereby countless thousands of plants could be propagated quickly and easily. The orchid world entered a new era. The orchid world entered another era in 1960 when Dr. George Morel showed how a tiny shoot (a meristem from root or shoot) from a new orchid plant could be taken into the laboratory and propagated in the laboratory.

These little cells would grow and be periodically chopped into smaller pieces. In time, large numbers of plants of this exact variety could be propagated in a short time. The orchid world was introduced to tissue culture or meristem tissue culture as it is properly known. What does it mean? It means that the commercial grower can select a very fine variety, propagate a great quantity of it quickly and cheaply, and sell that plant so that you have exactly what you want at a very low price compared to what you would have had to pay for it before tissue culture.

Where are we in the orchid world today? What is there for you to enjoy? Now you can have, with ease and with relatively little cost, an infinite variety of the finest orchids from throughout the world. Species, of course, are still available in their charming and unusual variations and the modern hybrids are of ever-increasing beauty and variety and many are fragrant. Hybridizers throughout the world are working to create even more beautiful orchids. The beauty is still there; their romance and mystique are still there; all that has changed is that it is easier for you to enjoy.

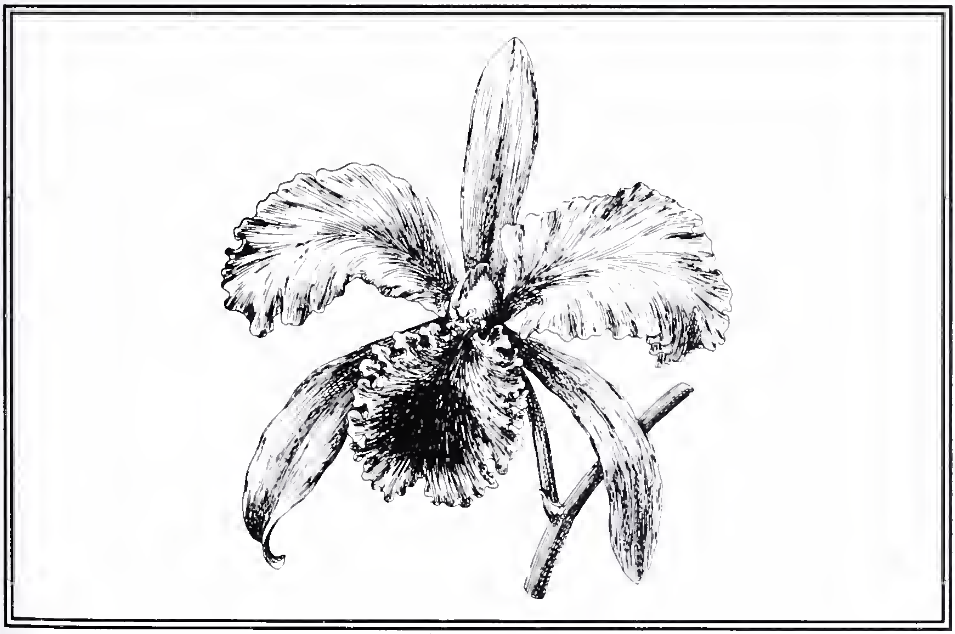
ORCHID HERITAGE

CHARLES MARDEN FITCH

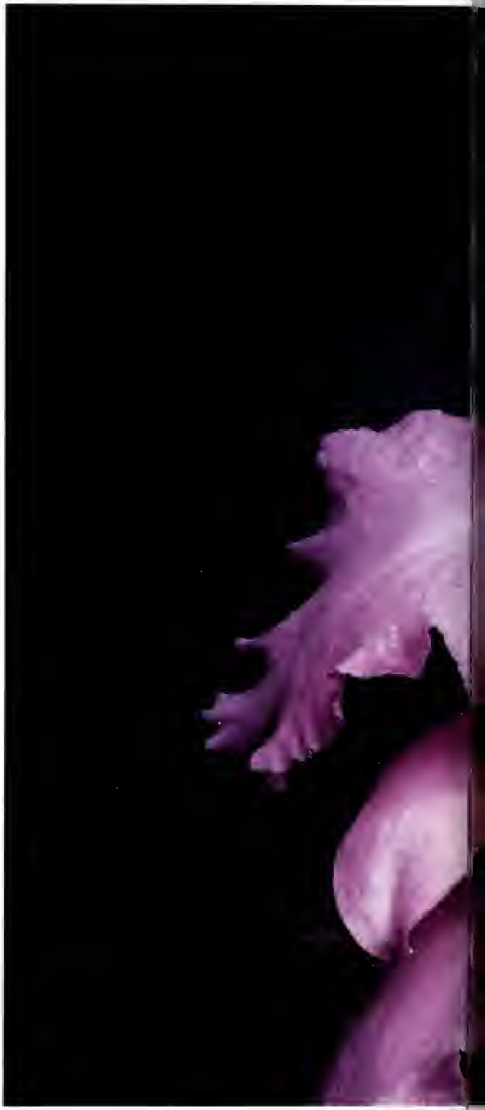
Orchid growers treasure the original species which come from tropical regions of the Old and New Worlds. In modern times the pressures of development and politics threaten habitats of our most precious orchids, yet knowledgeable individuals in tropical countries often strive to protect the remaining plants.

These photographs feature tropical orchids, wild and cultivated. The survival of orchid species in the tropics is often related to how these species are appreciated by local growers and politicians. Effective protection follows interest, love, and a desire to save the unique orchid heritage of tropical regions.

CHARLES MARDEN FITCH, *Mamaroneck, New York, is a well-known photographer, writer, and lecturer. He is a frequent traveler to the tropics to search for and photograph new plants. He is Guest Editor of this handbook.*



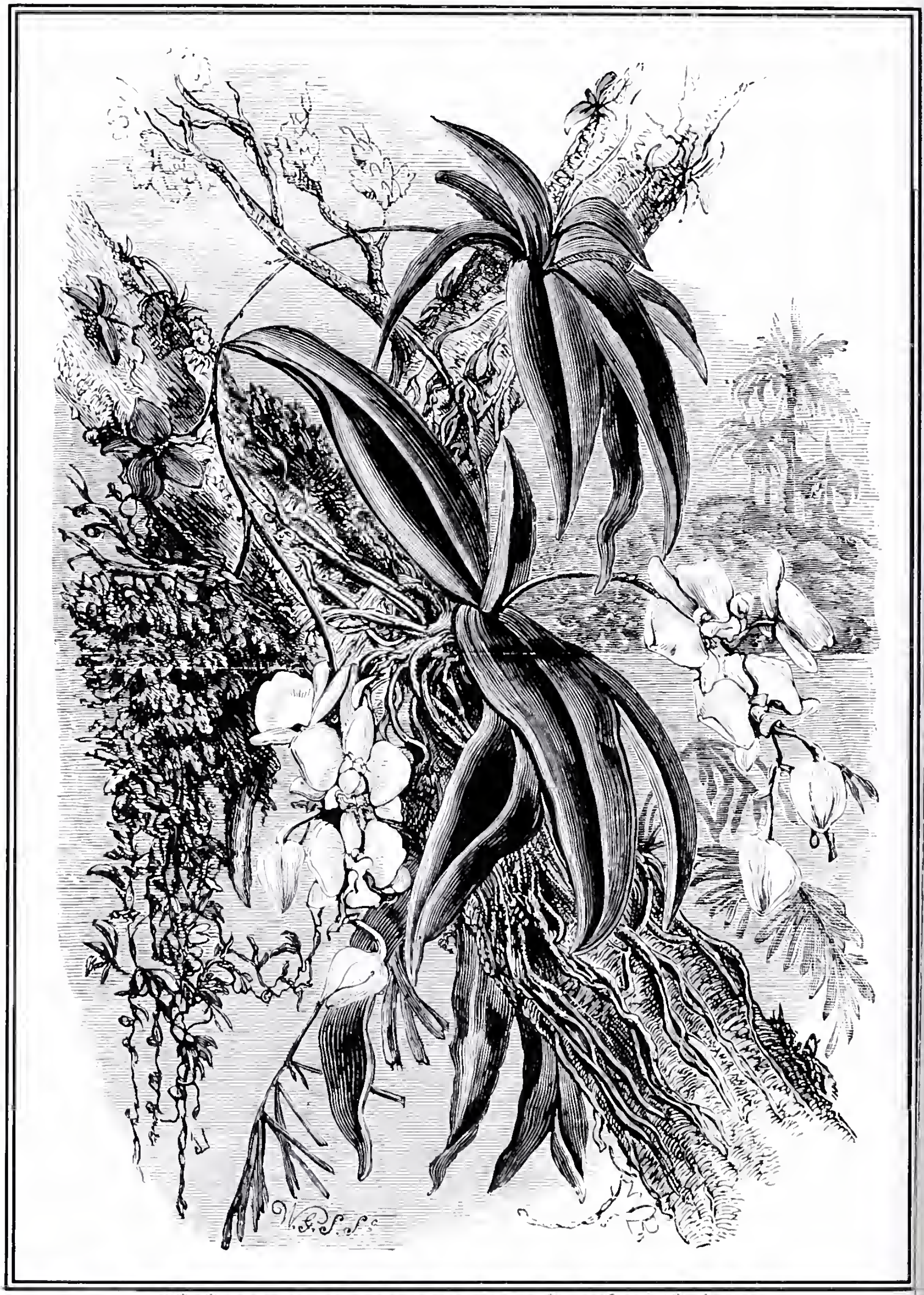
Cattleya mossiae



Above: *Cattleya mossiae,* a popular orchid often seen in awards judging.

Top left: *Paphiopedilum* Joanne's Wine 'Krull-Smith'.

Bottom left: *Brassavola nodosa* growing in its natural habitat in Mexico.



Phalaenopsis growing in its natural rainforest habitat.

THE CLASSIFICATION OF ORCHIDS

PHILLIP CRIBB

Biological classification is the direct result of man's attempts to come to grips with the vast numbers of living organisms in the world. In the Plant Kingdom alone there are estimated to be 250,000 species of flowering plants. Of these, some 17,000 are thought to be orchids according to Willis (1973) and Dressler (1981) while other authorities suggest that this figure might be on the low side. Whatever the exact figure, no one can deny that there are far too many for anyone of us to remember or even begin to know without some help. That help is provided by recourse to one of the many classifications of the orchids—schemes which seek to arrange the various orchids in some sort of easily accessible order.

Simple Classifications of Orchids

Not all classifications are complicated. Indeed some of the most widely used are the simplest and oldest. Every grower of orchid species uses classifications of various sorts in dealing with his collection. He may have several glasshouses each with a distinct environment—cool, intermediate and warm, for example, and will separate or classify his orchids into those categories so that each can be grown under the conditions best suited to it. Even the grower with a single glasshouse will know that some parts of his house suit certain orchids better than others and will place his plants accordingly.

Perhaps the most widely used distinction made by orchid growers is between terrestrial (land grown) and epiphytic (grown off the ground) species. Terrestrials will often be grown in a soil-based compost while epiphytes will be grown on bark or wood blocks or in chopped bark in pots or hanging baskets. All these methods of categorizing plants are forms of classification!

All these classifications are based on one, or at the most, a few features of orchids. Each is useful but only within its limited brief. They are called artificial classifications and often group together quite unrelated or unlike orchids.

The history of orchid classification is one of the production of schemes that tell us more about the orchids incorporated into them. Early schemes of the nineteenth century attempted to group "like with like" while more ambitious classifications of recent years have attempted to group together orchids that are related in an evolutionary sense.

The Species—The Basic Unit of Classification

In all classifications of living organisms, the basic unit used is the species. A

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A taxonomist studies an orchid herbarium sheet which is used for traditional classification studies.

typical definition of a species is that given by Jeffrey (1982) as "a series of similar intergrading and interfertile populations recognizably distinct from other such series, and separated from other such series by genetically controlled barriers preventing interbreeding." For animals, this definition of a species is relatively easy to apply. However, for plants, and orchids in particular, it is often impossible to provide information on breeding behavior and we usually have to rely on the far more subjective notion of morphological similarity to define the species. In other words, if two orchids look alike then they are assumed to belong to the same species, if not, then they are assigned to different species.

This is not always a satisfactory method of delimiting a species because plants of the same species can and frequently do vary, the major causes of variation being the effects of environment, mutation, and genetic recombination. Nevertheless, in most cases, orchid species are delimited on morphological grounds alone. [Classified according to structure, mainly of flower parts. Ed.]

Categories Above the Species Level

The base unit of classification is the species but there are several other categories at higher ranks that are also used. These categories, arranged in ascending order, are genus (plural genera), subtribe, tribe, subfamily, and family. The use of a particular category reflects on the similarity and relationship of the constituent elements. Thus species that are closely allied and morphologically similar are placed in the same genus. Some degree of crossability, which in orchids may be considerable, is also indicated. Species that are relatively distinct and not closely related are placed in different genera. The degree of cross compatibility is generally less than between species of the same genus and, indeed, is usually non-existent in unrelated genera.

In orchids, the genera are usually grouped into subtribes, the subtribes into tribes and the tribes into subfamilies. In Dressler's system, mentioned later, there are six subfamilies recognized. Of these the Apostasioideae and Cypripedioideae each comprise a singl tribe while the Spiranthoideae has two the Orchidoideae and Vandoideae fou each, and the Epidendroideae six.

The rank of the categories from subtribe upwards can be recognized by thei Latin endings as follows:

CATEGORY	LATIN ENDING	EXAMPLE
Genus	Any but usually *-us, -a, -um*	*Anguloa*
Subtribe	*-inae*	Lycastinae
Tribe	*-eae*	Maxillariea
Subfamily	*-oideae*	Vandoideae
Family	*-aceae*	Orchidacea

The Beginnings of Scientific Orchid Classification

The species concept was well established by the time scientists began t realize the wealth of orchids in th world. During the late eighteenth an early nineteenth centuries orchid flowed into Europe and particularly int the British Isles from all over the world. In particular, as the tropics of India, Southeast Asia and the Americas were opened by intrepid explorers and collectors, exotic orchids flooded into Britain and the mania for growing orchids began. John Lindley (1799-1865) was ideally placed in London to see these orchids firsthand and he rapidly became the acknowledged expert on orchids, naming upwards of three thousand species. H.G. Reichenbach (1823-1889), his successor, named many more. Estimates now of the number of orchid species range from fifteen to thirty thousand—far too many for any one person to deal with, let alone remember. The need for classification or scheme to deal with these vast numbers and to bring them down to manageable proportions became ever more apparent. Lindley in his *Genera and Species of Orchidaceous Plants* (1830) produced the first significant scientific classification of the family. The botanical features that characterize the orchids as a family are found in the sexual parts of the flower, in particular, the column that bears both the male (anthers) and female (stigmas) organs. Lindley distinguished seven major groups within the family, based on their column features, in particular the number of anthers, and the manner in which the pollen was held in them. George Bentham (1800-1884) in his and Sir Joseph Hooker's *Genera Plantarum* (1883) expanded upon Lindley's classification to produce a more detailed treatment that was widely accepted.

The first major departure from classifications that relied almost entirely upon the characteristics of the column was that proposed by Ernst Pfitzer (1846-1906) in Engler's *Pflanzenreich* (1895). His scheme incorporated vegetative as well as floral characters. Rudolf Schlechter's classification scheme published in *Notizblatt des Botanischen Gartens Berlin, Dahlem* in 1926, incorporated many of Pfitzer's ideas as well as those of Lindley and Bentham. Schlechter's classification has been widely followed since it was published. Like its predecessors, it attempts to place like with like by assessing a number of morphological features both floral and vegetative. The result is a useful scheme in which the major divisions within the family are firmly outlined.

The ideas of Charles Darwin on the evolution of living organisms outlined in *On the Origin of Species* (1860) have not unnaturally exercised a great influence over the thinking of botanists. At first, the temptation to suggest that similarity necessarily meant relationship led to various classifications based upon overall similarity being given evolutionary overtones. Convergent or parallel evolution is, however, widespread in the orchids. Quite unrelated species can look alike, e.g., the habit of *Angraecum distichum* and *Dendrobium leonis* and the flowers of *Cattleya, Sobralia* and *Epistephium.* Therefore, more recently, fresh attempts have been made to produce classifications that better reflect evolutionary relationships. Parallelisms, for example, can frequently be identified by assessing large numbers of characters.

Modern Orchid Classification

The most recent and thoroughly worked-out classification is that of Dressler in *Orchids, their Natural History and Classification* (1981). Evidence from floral and vegetative morphology, anatomy, cytology, and crossability have all been used to construct the classification. In it he recognizes six subfamilies. The Apostasioideae, with two or three anthers, are a primitive group comprising two genera seldom seen in cultivation. The Cypripedioideae, the well-known slipper orchids, are similarly rather primitive with two anthers and a characteristic slipper-shaped lip. The remaining four subfamilies, the Spiranthoideae, Orchidoideae, Epidendroideae, and Vandoideae, all have flowers with a single anther. The vast majority of cultivated orchids belong to the last two subfamilies. These contain the majority of the epiphytic species, which themselves comprise the majority of the orchid family. The Epidendroideae contains genera such as *Cattleya, Laelia, Sophronitis, Coelogyne, Vanilla,* and, of course, *Epidendrum* itself. The Vandoideae contains genera such as *Cymbidium, Oncidium, Odontoglossum, Miltonia,* and the monopodial orchids such as *Vanda,* and *Phalaenopsis.*

Although Dressler's system is essentially a natural classification, he does suggest that his arrangement reflects the evolutionary advance of the orchids from the Apostasioideae, with species that have most primitive features, to the highly evolved members of the Epidendroideae and Vandoideae. There are nevertheless species in each subfamily with primitive features suggesting that the evolution of the family has been reticulate rather than straightforward.

New methods of analysis, such as cladistics (a way of constructing or developing ideas about the evolutionary history of a group of plants that can tell us about the evolution of features and hence the classification of the group), will no doubt clarity areas within such classifications as Dressler's. However, it is fascinating to see how much in common his classification has with the early efforts of Lindley.

How a Classification Can Help the Grower

It is easy to see how artificial classifications that divide orchids into such groups as terrestrial and epiphyte; cool-, intermediate- or warm-growing; clustered or creeping habit, and others can help the grower. It is perhaps less easy to appreciate how a modern classification such as that of Dressler can be of use to the grower.

The modern classification attempts to place together orchids that are related to each other in terms of overall similarity and in an evolutionary sense. The compatibility of species in such genera as *Cattleya, Laelia, Sophronitis, Schomburgkia* and *Epidendrum* is well known. Not surprisingly we find these genera closely placed in Dressler's classification. The juxtaposition of genera in his classification might well suggest to the hybridizer fresh possibilities for his crossing program. For example, Dressler lists fifty-seven genera as closely allied to *Oncidium* and eighty-six genera to *Phalaenopsis*—surely the building blocks lie here for future hybridizing programs.

Close proximity in a classification may also give the grower clues to the cultural requirements of a species new to his collection or to its sensitivity to various chemical sprays provided he knows the requirements of allied species.

Every grower wants his orchids to be identified and named correctly. It is here that classification and an understanding of relationships can help. If the grower recognizes in an unnamed plant features common to other plants in his collection it will enable him to place the plant in its correct genus or, at least, close by. Reference then to the right section of one o the many excellent identification manuals will usually enable an accurate identification to be made fairly rapidly.

Orchid classification then is a manmade aid to enable us to cope with the vast numbers of species in the orchid family. An understanding of how orchids are classified can help the grower to understand his plants and that undoubtedly will lead him to grow them better.

OVERCOMING THE PITFALLS OF THE BEGINNER

M.M. Brubaker

Considering the ruggedness of the commonly grown orchids and the conditions tolerated in nature — long periods of drought, torrential rains, tropical sun, and almost nothing in the way of nourishment — one wonders why there should be any difficulty in growing them. Some of the difficulty may be psychological. The delicate and intricate appearance of the flowers and the awe that surrounds this family of plants leads the beginner to think that their growth must require meticulous skill. A little study of their peculiarities and attention to a few details are all that are needed to grow some of the showiest orchids.low some things worth bothering about.

Watering • For beginners, the most difficult aspect of orchid growing is watering. To understand this, one must appreciate the difficult transition for the epiphyte orchid from tree limb, where the roots are constantly exposed to air, to pot. The roots must have fresh air even if drying of the surrounding material is necessary to let it in. There is consequently a close relation between potting medium and watering technique. A change in the potting medium usually requires altered watering practice.

Beginners are inclined to make rather impulsive changes in the potting medium. A great variety of media have been successfully used. The British grew magnificent orchids for more than half a century in mostly peat and sphagnum moss. Media as different as lumps of fir bark, fern root, coconut husks, and gravel are used today, and each requires a different watering practice. It is best to stay with a selected potting medium until proper watering has been learned, and then make any change cautiously.

As the potting medium ages and breaks down, watering becomes a much more critical matter. Often the beginner is found struggling with a gift orchid that needs repotting in fresh medium rather than skill in watering. With cattleya-type orchids and many others, light-colored roots "crawling" on top or near the surface of the medium, and plump front bulbs indicate proper watering.

A corollary mistake of beginners, when they realize they are overwatering, is to cut down on the amount of water rather than the frequency of watering. Orchids need to be drenched periodically to leach out any accumulated salts, then allowed to dry out before being watered again.

Problems in Potting • It is a frequent mistake of beginners to change the nature of the potting medium without cleaning out the kind previously used. A particularly objectionable situation arises when a plant grown in osmunda is given a roomier pot in which fir bark is used to surround the old root ball. A fir bark watering practice will then surely rot the roots that are left in osmunda. The old osmunda should all

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M.M. Brubaker, *a retired chemist in the research department of E.I. du Pont de Nemours & Company, calls himself the director of a "run-down 50-acre private arboretum" at Chadds Ford, Pennsylvania, where he also engages in orchid culture.*

be picked out before repotting in bark. "Potting on," or surrounding the old root ball with fresh potting medium, is an acceptable practice if the old potting material is in good condition, and if the same kind is used. With fir bark, "potting on" is generally undesirable.

FAILURE TO BLOOM • Failure to bloom in healthy-looking orchid plants is most often the result of too little light. There seems to be a misconception that orchids enjoy the gloom beneath dense vegetation. On the contrary, many cattleyas, laelias, dendrobiums, oncidiums, vandas, and epidendrums flower most abundantly when they receive sunlight for at least part of the day. When grown in heavy shade, these plants have dark green leaves and do look better, but the leaves will blacken when exposed to high light, furthering the misconception that orchids resent strong light. It can be somewhat of a task to accustom a shade-grown plant to the high light necessary for abundant bloom.

LET THERE BE REST • It is often essential to rest orchids for good bloom or proper growth. Some commonly grown orchids do not need a real rest, although they have periods of less active growth when they should be watered less frequently. But a bonafide rest period is necessary for such orchids as dendrobiums, catasetums and cycnoches, and some oncidiums and odontoglossums.

Many dendrobiums must have a comparatively long rest period with very dry or cool conditions to initiate flower buds. Often the novice cannot bear to give his plants drastic enough conditions to obtain good flowering.

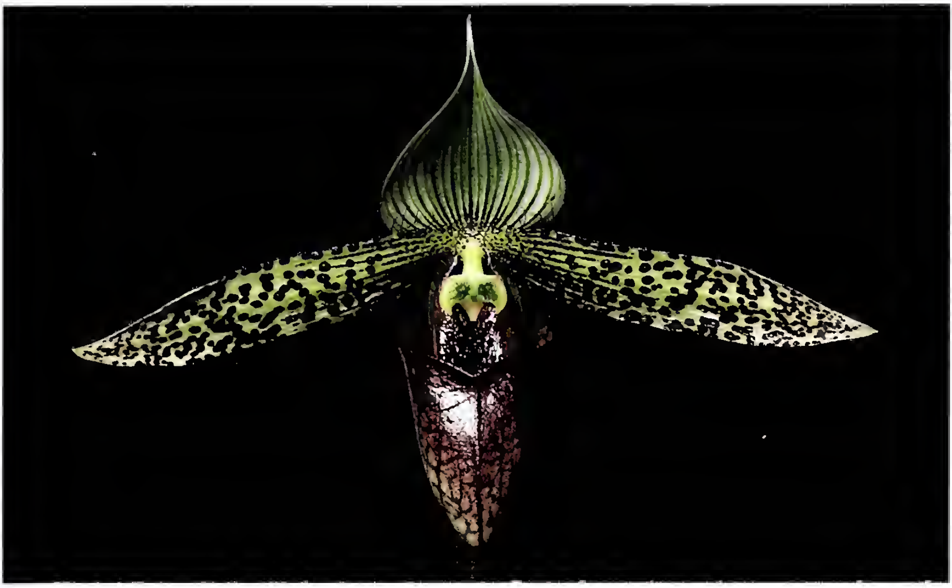
Cycnoches grow very actively in summer and require heavy watering. They then flower and rest. The bulbs are inclined to rot unless they are carefully dried during the resting period. It is important to wait until the new growth has roots before watering normally.

Many orchids require a rest period of reduced watering to prepare them for renewed activity and to preserve their normal yearly cycle of growth. These come from areas where there is an extended dry season and they usually flower before resting.

STAKING • Tall orchids can become quite disheveled if not properly groomed and supported. Dividing and repotting, particularly, are likely to yield top-heavy plants. For re-establishment, orchids must be held rigidly in the new growing medium. Staking is therefore essential, especially with such tall orchids as dendrobiums and cattleyas. I prefer the type of stake that grips the rim of the pot. It can be quickly made to fit a particular plant, is stable, and can be changed at any time without significant damage to the roots. A good wire bender and some #12 wire will solve most staking and support problems.

FOLIAGE DAMAGE • Wetting the foliage on soft-leaved orchids can lead to alarming disfiguration and serious set-back in growth. The new growth on catasetums, cycnoches, lycastes, anguloas, and calanthes is particularly prone to rot if water is left between the leaves. This is especially difficult to deal with when these soft-leaved orchids are under hanging plants or under a bench. Some help can be provided by dusting the growing cup of leaves with a fungicide. Where possible however, the best solution is to isolate the plants and keep the new foliage dry.

PRUNING • A fear of cutting up orchids seems common amongst beginners. It leads to unsightly plants oversized pots, and sometimes advancement of rot. Old bulbs and objectionable growths should be carved off at repotting time. It is best to dry the cut surface o the bulbs or apply a fungicide before potting. Conscientious growers *alway* sterilize all cutting tools, usually by flaming, to prevent spread of virus.



Paphiopedilum sukhakulii

PAPHIOPEDILUMS

THE TROPICAL LADY'S-SLIPPERS

LANCE A. BIRK

Paphiopedilums easily adapt to many growing conditions, including growing them in your own home. They will thrive and flower where many other orchids will not. Even if you have little experience in raising orchids, you will find that paphiopedilums offer some of the best rewards in the plant kingdom. They can be grown in a wide variety of potting soils and under artificial lights. Even some of the rarest species can be grown in the home, although a few need specific attention at certain stages of their growth. If you have a greenhouse or a separate growing room set aside for plants, your success at growing paphiopedilums will be assured. Another bonus is that there are seldom any insect pests and diseases are rare.

Not only does this genus offer a wide variety of exciting flower shapes and colors, but a diversity of plant sizes and some of the most beautiful foliage in the orchid family. Plants are mostly small (African-violet size) and are attractive even when out of bloom. Plants multiply rapidly and offer the opportunity for frequent division and

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LANCE A. BIRK *has made numerous trips to the ungle habitats of paphiopedilum orchids to collect pecimens an information for his most recent book,* ***The Paphiopedilum Grower's Manual.***

exchange with other orchid growers. With many species a single division can, within two year's time, produce a half-dozen separate growths. During the past fifteen years paphiopedilum species and hybrids have become readily available and can be found in most orchid collections.

Plants can be purchased from orchid nurseries and from mail-order firms as well as from other orchid growers. With all these fine attributes it is no wonder that paphiopedilums have enjoyed a tremendous burst of popularity. There are few plants whose flowers can last for more than a month, bloom every six months or produce consecutively flowering stems. Even with a small collection you can have paphiopedilum orchids in flower every day of the year.

Where Can I Grow Paphiopedilum?

One of the physical characteristics that sets orchid plants apart from other plants is their stomata, or leaf pores, that are fixed open. This means that they are not able to regulate the loss of moisture. If they are grown in an atmosphere which is lacking in sufficient humidity, orchids become desiccated and lose their vitality. If grown in an excessively humid atmosphere they can become susceptible to fungus or bacterial diseases. Generally speaking, lady's-slipper orchids are happy in the same temperature ranges humans are comfortable in, with somewhat more humidity. Ideally, humidity should be at least 50 percent with some fluctuation during the day and night. During the heat of the day humidity drops, but as night approaches it rises and remains high until the air warms again.

Providing extra humidity need not be a problem if there are other plants being grown in the immediate vicinity. Water loss from soil, pots, and foliage furnishes some humidity. In the home, during the drier time of year, or when the heat is on during the winter, grow plants on plastic or metal trays filled with gravel and some water. If conditions permit, you might find a place near a bright window (direct sunlight must be shaded with a thin curtain). Basements can also be utilized for larger collections which can be grown under artificial growing lights. Paphiopedilum orchids are very adaptable for this type of growing.

Nearly all species and hybrid paphiopedilums will grow and flower in what is called an intermediate orchid house. Whether it is in the home or in the greenhouse makes little difference. Ideally an intermediate house will range from 50 to 60 degrees F during the night. A cool house will range between 45 and 50 degrees and a warm house will average 65 degrees. During the daytime, while the sun is shining, a cool house will warm to 70 degrees or more, an intermediate house to 80 degrees or more, and a warm house can go above 90 degrees. It is common for higher temperatures to be found in cool zones, or lower temperatures to be found in hotter areas, and these temperatures are not as important to the plants as are nighttime readings. You can see that the intermediate readings fall within the range of human comfort.

Paphiopedilums require a 20 degrees (average) differential temperature between summer nighttime lows and winter nighttime lows in order to flower. In the home this may not always happen, so special treatment might need to be given to effect this. In the greenhouse it is an infrequent concern because of the naturally occurring fluctuation between summer and winter temperatures. Another problem encountered in growing plants in the home is the lack of sufficient light for certain species or the lack of total numbers of hours for one or two in particular. When orchids are grown under lights the timer can be adjusted accordingly, but when grown at a window it may be necessary to install supplemental lighting. Usually this is the case with only one or two difficult species.

These orchids need to have free air movement about them at all times. This does not mean that they should be grown in a cool, drafty location, but that they need freely circulating air currents to carry away excess moisture. Leaves should dry off within an hour or so after they have been watered. If you find them still wet hours after being watered, it means they are not getting sufficient air flow around them. At night, when temperatures drop below 60 degrees, or during the day when temperatures rise above 85 degrees, wet leaves are an invitation to diseases. Small fans, placed in strategic locations, will provide good air circulation. In the greenhouse fans should blow directly on the plants, but in the home the lower humidity can cause excessive drying so aim fans to blow above or away from the orchids. In many homes the lower humidity in the rest of the house draws away moisture from the plant room, thereby eliminating any problems of excessive moisture.

Since their light requirements are much lower than most other orchids, most paphiopedilums can be successfully grown and flowered in the home, usually near a window or other source of light. It doesn't have to be strong light in order to initiate flower buds since many buds are initiated by temperature drop and a rest period. Most species are found in rather shady jungle habitats and are particularly suited to growing under artificial lights. Paphiopedilum hybrids have basically the same light requirements as the species. Those species which need strong light in order to flower include: *P. philippinense, lowii, stonei, glanduliferum, randsii,* and *rothschildianum. P. delenatii* is peculiar in its needs. It requires long hours of sunlight as well as fairly bright light, which in northern latitudes may need to be supplemented with artificial means, especially during the winter months.

The best method of determining if your plants are getting enough light is by examining their leaves. Plants with dark green, droopy leaves aren't getting enough light. They are oftentimes more susceptible to injury or disease and become soft. Leaves which are light green, stand upright, or lie flat without drooping, and which are firm and strong to the touch are typical on plants grown in the correct amount of light. The more light your paphiopedilums receive, the firmer their growth and the more flowers they will produce. As with most orchids, paphiopedilums can be grown in very strong light; however, while they may bloom profusely, the plants will lose their beautiful foliage mottling, become reduced in size and look unattractive. What is needed is a balance between light and shade which will keep your plants looking good and continuing to produce numerous flowers. Paphiopedilum flowers lose their color in bright light, unlike many other flowers whose color is intensified. Also, longer flower spikes will develop in a shadier location so you might find that by reducing the light after the spike begins to develop will bring some much desired effects. Be aware, however, that in too shady a location the flower stems will droop and not stand up straight.

When Do I Water My Orchids?

One of the best means to determine when to water your plants is to knock one out of its pot to examine the root system. Pick a plant at random. Knock another out of its pot, or several others if you are not sure of what you are seeing. Not all plants are in need of water at the same time, but you will be able to notice if the potting soil is very wet, moist, or nearly dry. When you examine the roots of your plant you should look for fresh, whitish, fleshy root tips. There may not be many, but you will want to know if there are none. In this case there might be something wrong with the potting soil, your watering methods or perhaps it might indicate the time of year when there is relatively little root growth. Some plants

Paphiopedilum Tawny Blush 'Orchid Hollow'

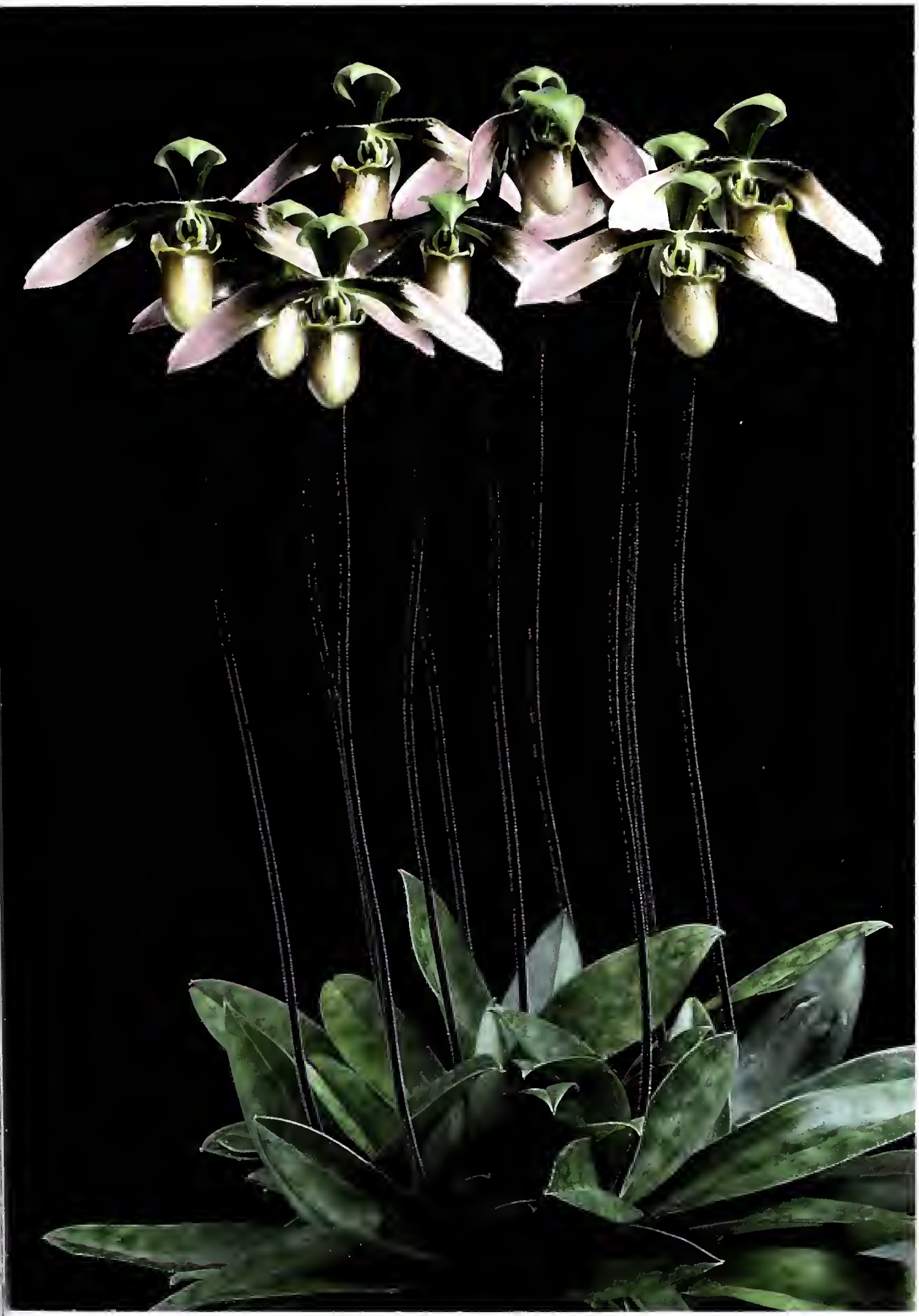
normally produce massive root systems while others only make a few roots. This is why it is important to examine several potted plants to learn the habits of each.

If there are decayed roots and a smelly compost, and if most of the air spaces are clogged with decomposed bark or other ingredients, repot the plant as quickly as possible. At this time, it is important to recognize why the breakdown has occurred. The greatest single cause of root loss, and the death of orchids, is overwatering. If this is not so in your case, examine the compost ingredients to see which one is decomposing so rapidly. Perhaps it might be caused by millipedes, which actually eat the compost. Perhaps you have placed a recently repotted plant alongside others which need more frequent irrigation and you unknowingly overwatered it. Maybe you watered the plant when it should have been at rest, or possibly it was placed where it couldn't dry off as fast as other plants nearby. As you can see, you must think like a detective and consider all possibilities. It's not difficult, it just takes a bit of doing.

Paphiopedilums are able to grow well and flower regularly in most any potting soil providing the watering frequency is controlled according to the density of the mix. A dense mix, one that is made up of fine, closely compacted particles, will hold more water for a longer period than a looser mix. There are growers who are "heavy" waterers, those who water often, as opposed to "light" waterers who do so infrequently. A heavy waterer should not use a dense potting mix for fear of smothering the roots of his orchids, and a light waterer should not use a loose mix for fear of starving his plants. If you can be home and in the greenhouse every day you might want to use a loose potting compost so that you can water your collection frequently. These orchids respond favorably to daily irrigation, but only if there is sufficient air movement and if the potting compost allows for rapid drying out.

If your schedule only allows you to be with your collection during the weekends then you probably will want to use a mix that holds water for a much longer period. Remember that these orchids like to be constantly moist, but never wet. Paphiopedilums are able to accommodate a wide variety of growing conditions which makes them ideal for beginners. Let a newly acquired plant adjust to your growing conditions for a few weeks before you change its way of life. If the plant was grown "wet" and you are a "dry" grower, or vice versa, the sudden change can stress it severely.

Well-grown plants which have not been repotted for several seasons will have developed a large root system, therefore need more water. Such plants can easily be watered every day without fear of damage to their roots. In fact, frequent watering may be needed in order to keep the plant growing. Sporadic, or infrequent, irrigation can cause the plant to begin its rest period at the wrong time or the potential for full growth can be limited. You should recognize the needs of these plants and contrast them with another plant which has been recently repotted. A newly-potted plant, even if it is the same size as the previous



Paphiopedilum appletonianum grown by Pat Conley — an AOS award winner.

plant, will not be able to utilize water through its root system until it gets over the shock of transplanting. Time required varies considerably, but you will recognize its recovery when it begins to make new root tips. Newly potted plants will benefit from water being misted upon them rather than having water placed at their roots.

Plants potted in plastic pots will need much less water than a similar plant potted in clay. The difference in water needs can be considerable; as much as 3 or 4 times as much for clay pots. Inside a very bright greenhouse you will find that plants need more water than those growing in more shade. If the temperature remains high during most of the daytime plants will also transpire at a high rate. Air circulation is what causes water to evaporate from the pots and the stronger the air currents, the more water will be lost. Humidity outside the growing area has a great influence upon the rate of water transpiration. Low humidity outside will draw the moisture from the growing area very quickly, and in many instances you will find that trying to maintain proper levels of humidity can be difficult. During the cooler months when the heater is in operation, plants will lose moisture rapidly because of the rise in temperature. During freezing periods the cold will draw water out of the plants and potting soil, then condense on the roof where it may freeze.

Many factors influence the time for watering your orchids. If you pay attention to your plants and "listen" to what your plants are trying to tell you (rather than trying to "talk" to them) you will find that it isn't really too difficult to identify their needs and respond accordingly.

Which Potting Medium Should I Use?

A potting medium must offer support for the plant and keep it in place firmly enough so that its roots will not be injured each time the plant is moved. It must retain sufficient moisture so that the plant will not dry excessively during the interval between waterings. It must also decompose slowly. Ideally a mix should last for two or three years. This will provide enough time for the root system to develop. If the mix decomposes too rapidly your plants will need frequent repotting which will keep them in a state of transplanting shock for too long a period. A potting mix should also be inexpensive enough so you will consider repotting it when it actually needs it, rather than whenever you can afford to do so. Finally, a potting soil should be lightweight.

You will find that there are rarely two people who agree on potting mixes. Each person seems to have his own favorite (for the moment, anyway) and can muster convincing evidence that his plants are doing beautifully in this "magical mix." To all but an experienced grower this certain potting mix might represent the salvation of his deteriorating collection of plants. However the most important factor is not the potting soil ingredients, but what they do fo the plants potted in them. Equally important is the balance between the mix and ai movement, light, and the grower's waterin schedule, all the other factors previousl mentioned. When you find a grower who i doing a great job of growing his plants, d not look at his potting mix, rather look t his methods of growing. Examine his watering techniques and his growin environment. If you find that you woul like to copy his potting mix, you must als copy his methods of growing. It may mea that you might compromise somewher but that is all right since you must find th combination which will work for you. Wha ever you do, you must resist the temptatio to try a new potting compound soone than every two or three years. It takes tha long for a plant to really achieve its be potential after it has been repotted.

Among the more popular potting mix for paphiopedilums is firbark, or oth types of tree bark. Medium grade is mo frequently used for mature plants and seedling grade bark is used for seedlings. To this bark may be added any number of other ingredients. Perlite or sponge rock, sand, gravel, moss,volcanic rock, marble chips, or bits of plastic chips are among other things commonly used either to cut costs or to add some missing nutrient which the plant might need. One of the most successful and easy-to-make mixes is straight firbark, plasterer's sand and chopped sheet moss. Proportions run approximately 8:2:1, by volume, according to the needs of the species being potted. Plants should be potted firmly using finger pressure only; a potting stick can damage roots. The special qualities of this mix are the variability of the water retention properties, its long life and the fact that it does not seem to produce toxicity as the components decompose. Also, you will find it practically impossible to overwater your plants, especially when you learn to fine tune this mix according to the needs of each species. Best of all, it is a very forgiving mix, particularly for beginners.

Pests and Diseases

While paphiopedilums are rarely bothered by most orchid pests, they are susceptible to some rather troublesome diseases. Fortunately these diseases are not widespread, but only cause problems in certain circumstances. The problem is cultural and therefore not difficult to remedy. When the temperature drops too low and the plants are wet, or when there is excess humidity and too little air movement plants are susceptible to diseases. Both fungal and bacterial diseases can cause considerable damage in a short period of time. Often a plant can be consumed overnight. Some diseases are not so rapid and a plant may be saved by immediate action, but you must act quickly to stop the spread to other plants.

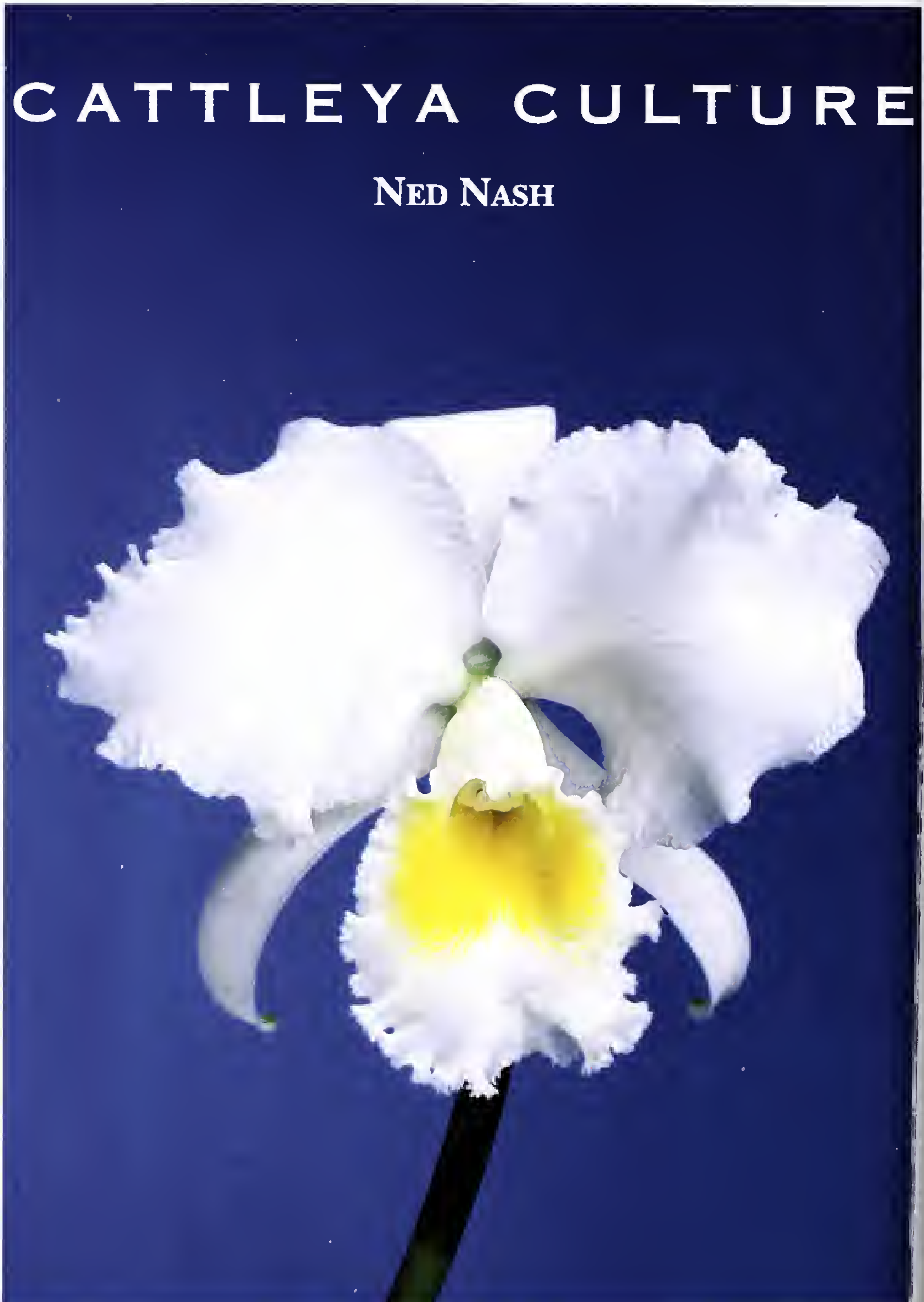
The damage caused by either fungi or bacteria is very similar and, while the chemicals to treat each might differ, the basic form of treatment is the same. Symptoms to look for are brown or black watery spots on the leaf surfaces. Sometimes the tips of the leaves die back, or perhaps the whole center portion of the plant has become affected. These diseases are spread by splashing water or by insects and if any part of the plant comes in contact with any other plant, it too can become infected. The first thing you must do in either case is to isolate the plant. If it has been severely infected and the whole center crown is discolored, it must be disposed of in a sealed container outside the greenhouse, or other growing enclosure.

If only a portion of the leaves has been affected you must remove them with a sharp, clean knife, cutting well into the healthy tissue. If there is any discoloration in the tissue it must be removed and discarded. Paint the cut with a fungicide and move the plant to a shaded location where there is good air movement. Do not water it for several days until you are certain that the disease has stopped. After two weeks you may return it to its growing location, but only if you are certain that there is no problem. An alternative treatment is a drench, where the whole plant is soaked in a bath of fungicide or bactericide, then removed to a shaded location, etc. The drench is actually a more thorough treatment, but be certain to let the plant dry off for six to eight days before watering it again.

Aphids and mealybugs are the two most bothersome pests. A sharp spray of water from a misting nozzle will dislodge most aphids. However, if they recur, or if you have trouble with mealybugs, you will need to use one of the insecticide sprays. Soil millipedes, snails, scale, and any other nuisances can be eradicated with an application of garden pesticide. While these orchids may be exotic, their insect pests can be controlled with pesticides that are readily available. ❦

CATTLEYA CULTURE

NED NASH



Cattleya Susies' Pride 'Talisman Cove'

"Everyone knows how to grow cattleyas." This assumption has probably led to more cultural errors, especially on the part of beginners, than any other orchid myth. It should be stressed that although the various elements of culture will be discussed in separate sections, this is simply for convenience and ease of understanding. All cultural factors are equally vital to the successful growth of the plant. In addition, no one factor may be separated from the others. That is, all facets are interrelated and should be in harmony, one with the others.

Light

Cattleyas require good light to grow and flower properly. Insufficient light is the most common cause of failure to bloom. There are other diagnostic features that will help to clarify the nature of the problem. If the foliage is a dark glossy green and the new growth is thin and weak, requiring staking, the plant has been grown with too little light. The foliage should be a medium olive green and the growths and flower spikes should develop strong and erect, without the need for staking.

Because light is essential to the chemical reactions which produce a plant's energy, a plant receiving too little light will draw stored energy from the older portions to subsist and to "manufacture" new growth. Since there is a net loss in any energy transfer, new growth will become increasingly weak until the plant finally succumbs.

Optimum light conditions will vary from region to region. In areas such as Florida or Hawaii, cattleyas may be given nearly full sun, while in California, plants are best grown with 40-50 percent sunlight. This is a good example of why close observation of plant growth is a better indicator of proper light conditions than relying on a light meter. In nature, cattleyas grow near the edge of the forest canopy where they receive bright, dappled sunlight. If they are exposed to full sun, they burn, just as they would in cultivation. It is not the light itself that will burn the foliage, but the heat buildup caused by the light. Overheating the foliage is the limiting factor in windowsill culture of cattleyas because it is difficult to provide sufficient light to the plants without overheating the foliage. Even if the leaves don't actually show the symptoms of burning, physiological processes may become so stressed that the plant will grow poorly. This is why the smaller-growing cattleyas are so popular for windowsill culture; it is easier to provide them with sufficient light without overstressing the plant.

A word of caution: plants that have been grown with too little light will burn even more quickly than those that have been grown with proper light. Remember your first day at the beach after a long cold winter? The fact that the dark green foliage will draw heat even more quickly only exacerbates the problem.

A good test for heat buildup is to feel the leaf with the palm of the hand. The leaf should be cool to the touch. If it is warm or hot, the temperature should be lowered. A temporary solution, especially if one lacks artificial cooling, is to increase air circulation and spray the plants lightly overhead.

Temperature

Light and temperature are closely related. In nature, cattleyas may be subjected to temperatures ranging from the low 40's to 100 degrees F or more. Some knowledge of the species background of any given hybrid is helpful in determining which microclimate within your

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growing area is best suited to that plant. Most growing areas have microclimates that can accommodate differences; for instance, it is warmer near the source of heat, so plants needing more light can be hung near the glass, with plants needing less shaded by the larger plants.

Most cattleyas thrive with a temperature range of 55-60 degrees nights and 75-85 degrees days. The 15-25 degrees differential between day and night is essential for proper growth and flowering. Many orchids, cattleyas included, have a metabolism that manufactures sugars during warm daylight hours, then utilizes them to complete the process during cooler hours. This point is important because unless a plant receives a cool, dark "rest" it will quickly exhaust its food reserves.

It is essential to stress common sense here. While cattleyas require a temperature differential to do their best, do not go overboard. Experienced growers have found that cattleyas do their best if the temperature differential is not too great and the temperatures are at the lower end of the spectrum. The plants will grow best and flower at maximum potential when grown to 80 degrees during the day and 60 degrees (or a little lower) at night. This regime does not stress the plants, allows them to grow under the most favorable conditions, and provides the best flower quality.

Flowers developed under even temperatures have the best size and substance because they have developed slowly and evenly. The commonsense aspect enters when one has to decide the best temperature range for one's own geographic area. Intense fluctuation of temperature is what must be avoided.

It is generally thought best to grow younger plants, especially those right out of flask, a little shadier and warmer. Not only does this give the younger and more fragile seedlings a better chance of survival, it gets them off to a "running start." Grow young plants with 65-68 degrees nights. As they are potted on from flats into individual pots, provide 62-65 degrees at night. When potted for the last time before first-flowering, move them into mature plant conditions. This method pushes the seedlings to an earlier first-blooming, yet gradually "hardens off" the plants so that they do not continue to require the higher temperatures and additional shade.

Effective temperature often consists of no more than proper ventilation and air movement. There should be just enough air movement to eliminate stale pockets of air. This will tend to maintain even temperatures throughout the growing area, and the elimination of the still pockets helps to avoid the fungal problems that can begin in such areas. In mild areas, higher temperatures can be mitigated in greenhouses by having a higher-ridged roof with vents at the ridge. In such cases, bottom vents are a useful addition, as the cool air can rise through the house and out the ridge vent as it warms. This also provides air circulation without the use of fans.

In cooler climates, higher houses are undesirable because of the large volume of air that is necessary to heat. In smaller houses a fan is needed to provide more active air circulation.

With just a little practice, you can readily recognize by "feel" if the growing area is right. The area should feel light and buoyant. The air should be a pleasure to breathe, full of earthy smells with plenty of oxygen. If *you* feel good in your growing area, so will your plants.

Watering and Humidity

The second most common problem is improper watering. Most cattleyas have relatively thick fleshy leaves and thickened stems or pseudobulbs (water-storage organs). Plants possessing such characteristics have them to survive periodic dryness. A dry season in the tropics is one where it doesn't rain every day. Generally these dry seasons are during the cooler winter months.

In nature, cattleya roots are exposed and dry rapidly. The roots will not tolerate extended periods of wetness. The absorbtive layer of the roots, the velamen, takes up water like a sponge. When it is fully charged with moisture, no gas exchange can occur. This condition can rapidly lead to rot. Although we generally grow cattleyas in pots for convenience, their need for cyclic drying and wetting remains.

Coarseness of medium for good drainage duplicates the cyclic wet-dry nature of the plants' native habitat and provides the circulation of air around the roots that the plants require. Many growers tend to fuss over the plants and, consequently, many plants have succumbed to overwatering. Remember that cattleyas have evolved to be drought-tolerant and simply will not stand for too much water at their roots.

Several diagnostic tests can be performed to tell when cattleyas need water. Because clay is porous it breathes, hastening the drying of the mix it contains. For this reason clay pots generally require more frequent watering. The "sweating" of moisture from clay pots can give a hint as to whether the plant needs water. By lifting the pot, one can see whether a ring of moisture has been left where the pot was sitting. If there is a ring, there is plenty of moisture left in that pot. A trick that works well in both plastic and clay pots is to insert a freshly-sharpened lead pencil about halfway into the mix. If the wood is dark with moisture when the pencil is withdrawn, the plant does not require water.

Today's lightweight mixes in combination with the lightness of plastic pots can give valuable information on the amount of moisture present in the pot. Immediately after watering, lift the pot; it will be relatively heavy. Lift that same pot before you think it needs water; it should be relatively light. If it isn't the plant doesn't need watering. With a little practice, the weight and balance of a plant in a plastic pot can tell you just how much water is left in the pot.

Very few of us have either the time or the inclination to test each of our plants individually. If the plants are set up with pots of the same size together, and one remembers the intervals between waterings for a given pot size, the initial learning period can be greatly reduced. It is a good idea to double-check your presumptions on watering intervals every so often.

Seasonal influences are important factors in determining watering intervals. Areas like Florida and Hawaii experience seasonal variation in day-length and cloud cover, however slight. As one moves away from the equator, these factors become increasingly important. Plants will generally require less water during winter months owing to the reduced growth rate that results from shorter days, cooler temperatures, and the lower angle of the sun.

Longer and warmer days and the increased growth rate they bring will necessitate more frequent waterings. Many new roots are forming, and increased fresh air evaporates moisture more quickly. It is especially important to take advantage of this quickening growth in cooler or more northern climates. The growing season can be quite short in these areas and it is vital to utilize it efficiently. This requires monitoring the plants' water needs more closely to avoid slowing growth by insufficient water. Only when the plants' water needs are correctly met will the plants perform to true potential.

Adequate humidity goes hand-in-hand

Laeliocattleya Stoned Pony

with proper watering practices. In nature, cattleyas are subject to fluctuating humidity. A good rule of thumb is to increase relative humidity when temperatures rise and to reduce it when temperatures drop. The increase of humidity with rising temperatures will keep the plant's increasing transpiration and water use from outstripping its capacity to supply water from the roots. Lowering humidity with lowering temperatures helps prevent atmospheric moisture saturation which can lead to fungal and bacterial problems.

Young seedlings require more water and humidity because they do not have the well-developed water-storage organs of mature plants. More frequent waterings are required; and if one is fortunate enough to be home to tend the plants during the day, the seedlings may be lightly misted as necessary.

Fertilizing

In nature cattleyas grow on trees and rocks, which provide few nutrients. Fertilizer comes from many external environmental sources. Birds and other animals leave their droppings, leaves collect around the base of the plants, and nutrient solutions are washed over the plant from above by the frequent rains. Since the nutrients are supplied sparingly by outside sources, we can infer that cattleyas are moderate feeders. Most commercially prepared fertilizers for orchids should be used at one-half strength once a week.

Potting and Mixes

Osmunda, hapuu, firbark, charcoal, and many other materials share the desirable characteristics needed for cattleya potting material. One or another may work better in a particular area or for a particular grower, but all have relative merits and drawbacks. What works best for you and is cost-effective is the best mix. Give a fair trial to any new mix or material. This means a year, preferably two, of using that mix before a final decision is reached.

Laeliocattleya Brilliant Orange x *Sophrolaeliocattleya* Jewel Box

It is wise to evaluate a mix *before* decid-ng to commit any of your plants to it. actors to consider include: Conve-ience—is it easy to use? Is it readily vailable locally and is it likely to remain o? Finally, is it reasonably priced? If hese questions can be answered to your atisfaction, give the mix a try.

The majority of cattleyas in North merica are grown in firbark and/or ree fern mixes. They provide drainage nd aeration, and readily available com-nercially prepared fertilizers can be used o meet nutrient requirements.

Common sense dictates that a plant in ud should not normally be repotted. Not only will the flowers be poor, but the lant's strength will be sapped by having o open the flowers with little root sys-em. If the plants *must* be potted while in ud, it is best to break off the buds to rotect the plant's future productivity. A lant with mature leads that have already ooted is also a poor candidate for repot-ng. Waiting for fresh root-tip growth or new growth will help to ensure the plant's speedy recovery from the shock of repotting.

As one grows and learns from his plants, a sense of what to report will develop. Observation of the plants throughout the year helps the grower to learn at what growth stages a particular plant, or type of hybrid, will sprout roots. Once this is learned, it is best to repot just before the new roots are initiated. This added precaution will prevent the newly emerging and very tender root-tips from being damaged in potting. Many times, if the newly emerging root-tips are lost, the plant will not grow any new roots from that growth and must wait until a new growth is formed.

A plant's flowering season will also influence when it is to be potted. Most spring-flowering varieties root immediately after flowering while fall/winter varieties root when the bulb is barely mature, some months before flowering. This can pose a bit of a problem if the plant begins to root while it is in bud. The only way around this is to pot when the plant is making new growth and hope that the shock will induce it to make new roots sooner than it ordinarily would. When potting, roots should be shortened to approximately 3-4" to reduce the amount of old material in the new mix. With luck these shortened roots will branch, but often they may not. This is another reason why it is so important not to damage the root-tips on the new growth.

One of the most common mistakes in potting cattleyas involves improper placement in the pot. Most people seem to want to place the developing growth level with the surface of the mix at the expense of the back portion being buried. Because most cattleyas tend to climb a bit, that is each new growth develops relatively higher than the last, this habit of potting allows the plant to rapidly grow out of the pot, letting the roots and new growths be exposed to the air and pest problems. More properly, a cattleya should lean across the pot with the rhizome level with the surface of the mix, the new growth nearest the center. The bulbs may lean forward, but the new growth will orient itself upright. It is important that the mix be uniformly firm throughout the pot to prevent any channels from forming where water might too quickly run through.

Pests and Problems

Cattleyas in modern collections suffer from very few pests. Their tough, leathery foliage is not attractive to sucking pests. Sensible use of available insecticides will take care of any minor infestations. It is never a good idea to spray insecticides as a prophylactic measure. One is encouraging resistant strains of pests by this type of usage.

Malathion is the insecticide of choice for most sucking insects. The tough foliage of cattleyas is not as adversely affected by the oil carrier as that of many other orchids, and Malathion is effective against scale, mealybugs, and aphids. (Mealybugs are usually a more serious problem on young seedlings and dwarf hybrids, with their softer foliage.) Powdered wettable Malathion may be indicated in these cases as it does not need the oil carrier. Aphids can be an insidious pest because they usually attack only the flower buds, and these are easily damaged by either the oil base of the insecticide or the force of spraying. Insecticide residues are also undesirable on flowers either. If the buds are not too advanced, thorough spraying with plain water usually will dislodge aphids.

One application of an insecticide will rarely take care of the problem. Most commonly-used insecticides affect only one stage of an insect's life cycle. For this reason, three to four applications at seven to ten day intervals are recommended. We have not found systemic insecticides generally effective for cattleyas (except Cygon for boisduval scale). Our suspicion is that because cattleyas grow relatively slowly, the systemic is poorly or weakly distributed throughout the plant.

Soil-dwelling pests are a minor problem in cattleyas. Snails and slugs do not care for the tough foliage, but they do relish flower spikes and buds. Regular applications of Metaldehyde granules will stop these pests. Sowbugs and/or millipedes occasionally infest the mix. A Diazinon drench will stop this problem. Sowbugs can wreak havoc on mounted plants by eating the fresh root tips. Diazinon or Sevin spray will prevent this.

Perhaps no other subject raises so much controversy as virus in cattleyas. Virus is a serious problem in many cattleya collections around the world and at this time (1985) it cannot reliably be cured. It is very easy to spread a virus from plant to plant, and diagnosis of a virused plant from foliar symptoms is inexact (although you can make a good guess). You *must* disinfect your cutting tools after contact with each plant and heat (passing the tool blade through a flame) is the only sure method. Virus does not necessarily affect the vigor of a plant, although it may. Unfortunately the more we learn about cattleya virus the more plants we find infected with it—plants apparently free of the disease. This is probably the most disturbing aspect of the virus problem.

Flowering

It must be admitted here that while nicely grown cattleya plant is an object o pride to its grower, it is really no mor than a means to an end. The plant is grown well so that it will flower. And quite frankly, most cattleya plants are not really attractive when not in flower, even f they are extremely well grown.

Place the plant so that the lead growth faces toward the maximum light. This allows the buds to emerge cleanly and he flowers to open untwisted on the stem. Make sure that the buds do not become trapped in the foliage as they emerge. Many cattleyas will not immediately initiate buds into their sheaths and may seem to rest before doing so. This is especially true in spring-blooming varieties. Temperature fluctuation can cause moisture to build up in the sheath, leadng to bud rot. This is often indicated by he sheath beginning to yellow and die. f this happens gently open and remove he sheath, taking care not to damage he young flower buds. The buds will usually still develop, but will need earlier taking because they do not have the support of the sheath.

If the spikes require staking, do it as he stem elongates. Once the stem begins to elongate, do not move or otate the pot. The plant should be left n the same flowering area until the flowers are fully ripe.

When misting or watering, try to keep water off the buds and blooms so as not o spot or bruise them. Any sort of chemical spray or dust should be avoided for he same reason. Flower buds are very ender and great care must be exercised not to bruise or damage them. What may seem an insignificant nick on a small bud will grow many times larger as the flower matures. Flower stems are also quite brite as they grow and are easy to snap.

A bad orchid requires just as much time and effort to grow as a good one. With energy at such a premium today, growers simply cannot afford to grow plants that do not perform satisfactorily. Study hybrid lines and growth habits so that your orchid acquisitions can be intelligently, and successfully, planned.

The smaller hybrids available today have many advantages. Beyond the fact that they occupy much less space, their more compact growth habit allows them to receive more light without burning. Many will endure both cooler and warmer conditions than their larger cousins. Another advantage is that the smaller types tend to be more prolific in their production of new growths.

When evaluating a plant's growth habit, whether standard or dwarf, several things need to be considered. A relatively compact and freely branching habit is essential. Bulbs and rhizome should be in proportion to the general size category of the hybrid. A 2" bulb size is no good at all if the rhizome is 2" between bulbs and doesn't branch. Ease of growth is another factor to look for. If a particular type is known to be touchy about when it is potted, it is wise to avoid buying hybrids of this sort unless the other parent has been very carefully selected. Note whether the plant has flowered from most bulbs, or is it a "hit or miss" bloomer? Productivity is an important factor because the best cattleya in the world is no good if it won't flower.

Cattleyas are still the most popular orchids. Their array of colors, forms, and sizes make them a truly versatile group of plants. Outstanding cultivars are more easily obtained than ever, and more exciting new hybrids are being bred and offered than ever before.

ADAPTABLE MINIATURES

H. Phillips Jesup

Orchid horticulture in the twentieth century has been largely concerned with orchids of imposing size in both flower and plant habit. These familiar types, however, were derived from relatively few species in a handful of genera. Despite the public conception of the flamboyant orchid, the fact is that among the approximately 30,000 species of orchids, the majority are small in plant size, flower, or both, and growers who have space limitations or who are simply intrigued with small, collectible things will find a wealth of miniature orchids to choose from. Some have showy flowers so large they nearly obscure the plant that bears them, others have an abundance of small flowers, while some sport an element of whimsy.

A resurgence of interest in orchid species has led some orchid firms to offer a wide selection of the products of evolution, among which are a diversity of small species. As with many other plant families, wild orchid populations are subject to heavy pressure from habitat destruction and over-collecting, and conscientious horticulturists will prefer to obtain their plants from nurseries that have raised seedlings from self-pollination of their stock. The hybridizers too have taken note of the popularity of miniature orchids and have been active in breeding for compact plant habit. Their efforts have been most successful in the cattleya alliance, the resulting dwarf cattleyas being known as "minicatts."

As is true of orchid species in general, the miniature species have evolved under a wide range of ecological conditions

Oncidium Catherine Wilson
(*O. triquetrum* x *O. pulchellum*)

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from high mountains to sea level near-desert; cool cloud forests to lowland jungle; fully exposed lichen-covered rock faces; shaded, mossy tree trunks; tree-top twigs in open savannah forest. Often the plant form gives a valuable clue to habitat, and therefore to culture. Prominent pseudobulbs and thick or pencillike (terete) leaves function as water-storage organs and denote brightly-lit habitat with relatively low rainfall, at least at a certain season of the year. On the other hand, broad, thin leaves and pseudobulbs that are vestigial or lacking indicate a uniformly high level of moisture and shade in the habitat. Culture should dovetail accordingly. Species vary in their adaptability to "captivity," but most are amenable if their particular needs of ight, humidity, moisture at the roots, and temperature are observed. Microclimates in the orchid growing area should be accentuated and utilized. In the home, a sunny window would best suit *Leptotes bicolor* or *Oncidium onustum*, while a Wardian case exposed to good light but no sun, and with the top tipped up for ventilation, might provide optimum conditions for cloud forest denizens and *Aerangis rhodosticta*.

A drop in night temperature of at least 8 to 10 degrees F is important for all orchids (as it is for most plants), and this is perhaps more easily achieved in a greenhouse than in the home.

Are miniature orchids more demanding in their care than their larger cousins? The answer is a qualified yes. While the cultural conditions for orchids from similar habitats are essentially the same regardless of the size of the plant, miniatures require closer attention. Small pots dry out faster than large, and the cork, branch, or tree fern mounts for

Restrepia cuprea

Ascocentrum miniatum

some will need frequent watering or misting to keep the plants turgid because the roots, exposed to the air, will quickly dry. A miniature plant with a problem will usually succumb much faster than will a bigger one, since it takes only a few mealybugs or scale insects to suck much of the life juices from a tiny plant compared with hordes for a large orchid. A fungus or bacterial rot can obliterate a little plant quickly if undetected for a short time. Vigilance is important. However, for the enthusiastic grower such extra attention comes under the category of fun rather than work.

Before discussing a handful among the multitude of attractive miniatures, the temperature requirements of each species, which are shown after the botanical name, should be explained.

W = warm (day temperature 75-85 degrees F, night 65 degrees)

I = intermediate (day temperature 70-80 degrees, night 60 degrees)

C = cool (day temperature 65-70 degrees, night 50 degrees)

These are ideal temperatures to strive for, but some variation, as long as other conditions are good, should do no harm. All of the orchids below are, in general, adaptable to home and greenhouse culture within the ranges of their tolerance. They are from 2-8" in height, except for a couple of the oncidiums which are vegetatively small but have bloom spikes up to 20 inches long. Species are listed in order of their temperature requirements, beginning with the warmer growers.

Warm-Temperature Miniatures

Aerangis rhodosticta (W) has a short, horizontal spray of 1-1/2 to 2" narrow leaves with bilobed tips, from among which emerges a bloom spike on the same plane bearing six to ten or more 1-1/4" flat flowers that face upward in a double rank. They are pure white with a prominent orange dot in the center of each. This is a shade-growing twig-orchid from Kenya and the Cameroons, and will grow best with good humidity on a small cork slab or cut section of a rough-barked limb.

Ascocentrum miniatum (W), on the other hand, is a sun-lover. A double row of heavy, stubby leaves marked with dark dots clothe a slowly elongating upright stem. From the leaf axils each spring arise one or two 4-6" "candles" of brilliant, closely-packed 1/2" orange-yellow flowers. The white aerial roots are as thick as a pencil and as rigid. This Far East species should grow well in a bright spot in the greenhouse, on a south-facing windowsill, or close to the lights in an artificial light set-up. A related species is *A. pumilum* (I-C) which is but 1-1/2" high, with needlelike leaves and tiny pink flowers.

Phalaenopsis equestris (W) is a dwarf relative of the larger "moth orchids" which are popular commercial cut-flower and hobbyist plants. It produces a cloud of small rose-pink flowers with darker lips which appear to float on branched bloom stems above the three to five broad, flat leaves at the base of the plant This one is a bit larger than most of the species discussed, and is of easy culture under conditions of warmth, shade, and moisture suitable for African violets.

Intermediate-Temperature Miniatures

Another relative of a horticulturally important group of orchids is the dwar *Cattleya luteola* (I). A somewhat creeping species, the paddle-shaped thick leaves and pseudobulbs total about 6" and resemble a scaled-down version of the familiar (and not very esthetic) cattley growth habit. Clusters of three to eigh yellow to greenish-yellow 1-1/2 to 2 flowers erupt from a sheath at the top o the pseudobulb in the spring. The lip are marked with red. This species, foun in Peru and Bolivia, prefers a resting period with reduced water after flowering, and requires bright light with some sun to flower well. Pots or mounts suit it equally, but do not over water pots.

Also in the Cattleya Tribe but quite different in appearance are *Leptotes bicolor* (I) and *Leptotes unicolor* (I). Both have pencillike round leaves, the former producing several spidery 2" white flowers with magenta lips, and the latter uniformly pale orchid-lavender flowers about half the size. The leaves of *L. bicolor* are 3-4" in length, while *L. unicolor* is a miniature version of its merely dwarf cousin. *L. unicolor's* rough-textured leaves and its flowers both grow straight downward. For this reason, it should be grown only on a mount, and if the plant is attached incorrectly with leaves pointed skyward, it will remedy that mistake, as subsequently-grown leaves will head sharply down. Both of these Brazilian species need bright conditions and not much water at the roots.

Laelia pumila (I) is yet another cattleya relative from Brazil and it resembles a dwarf version of a standard lavender florist's cattleya. The 4" flower seems enormous coming from a plant about the size of *Cattleya luteola*, and it sometimes outdoes itself by producing two such immense flowers simultaneously from a single growth. Pot or mount culture suits it equally, but the somewhat creeping rhizome lends itself better to a slab of tree fern fiber; it will quickly "walk" over the edge of a pot. Strong light but a less pronounced rest than *Cattleya luteola* will induce flowering.

In the genus *Laelia* are a number of very tiny species which grow in declivities on the exposed rocky summits of several Brazilian mountain ranges. They, along with some larger relatives, are collectively known as "rupicolous (rock dwelling) laelias." Species such as *Laelia bradei* (I), *L. longipes* (I) and *L. lilliputana* (I) have butter-yellow, white, and lavender flowers respectively, and make entrancing pot plants. Their pseudobulbs resemble green or reddish bullets or marbles, and the extraordinary succulent upright leaves are about 1/2"-1-1/2", although they may grow a bit longer under less harsh conditions in cultivation. Their flower spikes emerge from developing growths and flaunt 1 to 4 flowers which face upward and are of narrow-segmented cattleya form. Bright sunshine and ample water at the roots during the growing season, once the plants are established, are essential.

Neolehmannia porpax (Epidendrum porpax), (I) is definitely whimsical. The species is a mat-forming creeper, each stem bearing a single flower which at 1" is large for the size of the plant. Its dominant feature is the lip which resembles a shiny red-maroon grape, the narrow greenish dorsal sepal and petals framing it like a corona of exclamation points. This Central and South American species is easy-to-grow and prefers to be mounted so that it can ramble. Moderate light suits it well.

From Southern Japan comes *Neofinetia falcata* (I), the "Japanese Wind Orchid," a wonderful species for those who appreciate fragrance. Its cluster of showy pure white flowers exudes a very strong sweet scent at night, sufficient to perfume a room. The lack of color, the evening scent, and the long nectaries lead one to assume that the flowers are pollinated in the plant's native habitat by a species of moth. Vegetatively this orchid resembles a narrow-leaved *Ascocentrum miniatum*, but it does not require quite as much sun. The species has been hybridized with related genera to make a fine series of plants which, although a bit larger, are still dwarf, and bear flowers of rose-pink, orange, coral, and lavender-blue—although with little or no fragrance.

Neofinetia falcata

While *Oncidium onustum* (I) has been known to grow epiphytically upon cacti in dry areas of Ecuador, harsh native growing conditions do not seem to have resulted in a demanding plant. Although it is small, with short, heavy leaves and fat pseudobulbs, both red-mottled, the gracefully arching flower spike can reach 20". It bears many 1" flat golden-yellow flowers in a double rank, the lip comprising 75 percent of the flower. It revels in very strong light, and when it is in active growth *Oncidium onustum* requires frequent watering combined with rapid drainage such as it would receive on cork or tree fern mounts. Water should be reduced after flowering.

The West Indian equitant or fan oncidiums, of which examples are *Oncidium pulchellum* (I), *O. variegatum* (I), *O. guianense*, (I), and *O. triquetrum* (I) are a group of jewellike species. The flower

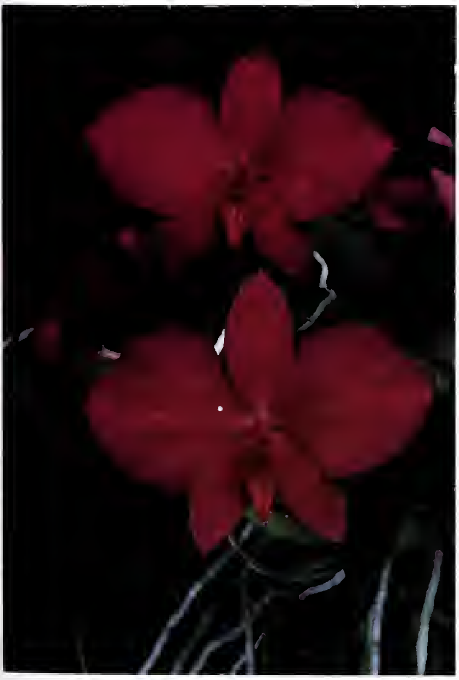
Laelia pumila 'Dayana'

colors of those listed are lavender, white-and-brown, yellow-and-brown, and red-and-beige respectively. Bloom spikes of varying length depending on the species issue from 2-4" fans of narrow, hard, channeled leaves and bear clusters of 3/4-1-1/2" blooms. The spikes often rebloom several times by producing accessory branches. Culturally, they require good light and excellent drainage on a mount or in a very small clay pot, combined with frequent watering. Hundreds of hybrids, many spectacularly colored and patterned, have been made within this group and require identical culture.

Similar in growth habit to the above but very different in flower is *Ornithocephalus bicornis* (I). The tiny, intricate white-and-green flowers are produced from a perfect fan of soft leaves which may orient itself sideways or upside-down. The flower structure resembles a bird's head and beak, and the generic name means "bird head" or, to some, "bird brain"! Shade and moisture suit this species, which is found in Mexico.

Easy to grow and generally available in the trade, *Pleurothallis grobyi* (I) of the American tropics is a representative of the myriad of genera and species in the Pleurothallid group. A true miniature, its wandlike racemes of tiny chartreuse flowers rise well above the 1/4" fleshy, orbicular leaves. Moderate light, frequent watering, and good drainage will maintain this species in good condition on a mount or in a pot.

Trichocentrum pfavii (I) from Costa Rica produces its 1-1/4" brown, white, and rose flowers with frilly lips, several to the growth. The leaves are short and thick, and it too can be grown in moderate light on a mount or in a pot.



Sophronitis coccinea 'Edelweiss'

Aerangis rhodosticta

Intermediate to Cooler

Flowering best in the cooler end of the intermediate temperature range, *Dendrobium bellatulum* (I-C) is a handsome miniature. Stumpy pseudobulbs are clothed with several silvery-gray leaves, and from the top, one or two surprisingly large, showy flowers emerge, generally in the fall or winter. White sepals and petals frame a spectacular lip, which is deep orange at the base becoming pale egg yolk near the end. It performs best with high light and needs a drier rest prior to flowering, corresponding with the end of the monsoon period in its native Thailand.

Dryadella lilliputana (I-C) looks like a tiny green pincushion studded with 1/4" flowers resembling tiny three-legged starfish, yellowish with dark dots. A slightly larger version is *Dryadella edwallii* (I-C). Both occur on scrubby trees in areas of Brazil and enjoy moderate light and a fair amount of water. The generic name refers to the Dryads, the mythical elves of the forest.

Oncidium cheirophorum (I-C) is a lovely dwarf species that is a pleasure to grow. Chunky dark-speckled pseudobulbs and short, thin leaves are the backdrop for late fall flowering of 6" branched spikes holding myriads of highly fragrant small flowers, the mass resembling golden yellow popcorn. Growing on trees along middle-elevation streams in Costa Rica and Panama, this species requires bright light and frequent watering in small pots.

Almost insectlike is *Restrepia antennifera* (I-C). Paddle-shaped, pointed leaves on thin stems support a succession of relatively large flowers from the juncture of stem and leaf, the most showy portion being the lateral sepals, joined in a boat-shaped body with either a yellow or white background heavily spotted with maroon. The dorsal sepal and petals are reduced to threadlike structures equipped with enlarged clublike ends reminiscent of butterfly antennae. Shade, moisture, and moderately cool temperatures will emulate the conditions of the restrepia's native Colombian Andes. This and other restrepia species may be propagated by leaf and stem cuttings, unusual among orchids.

Cool-Temperature Miniatures

For those with cool temperatures for at least most of the year, the Brazilian *Promenea xanthina* (C) will provide a wealth of proportionately large yellow flowers on a small, neat plant. The plant, too, is distinctive, with gray-green pseudobulbs and leaves, from which the single flowers emerge on short stems. Grow in medium light and with frequent watering for a specimen pot plant with many flowers.

Completing this introduction to miniature orchids are two representatives of the small but spectacular Brazilian genus *Sophronitis*, *S. coccinea* (C) and *S. cernua* (I-C). The former is a 2" plant which becomes smothered with exceptionally showy 2-3" round scarlet-orange blooms held just above the leaves. *Sophronitis coccinea* prefers moderate light and plenty of moisture in small pots, and requires coolness to do well. Less demanding is *Sophronitis cernua*, with clusters of smaller, brick red flowers. It grows at a lower elevation, and does best creeping on a mount. It should be kept rather dry and bright.

The species described above represent but a tiny fraction of the fascinating forms available in small orchids, and the challenge of assembling and successfully growing a diverse collection can be a rewarding (and consuming!) horticultural pastime. ❦

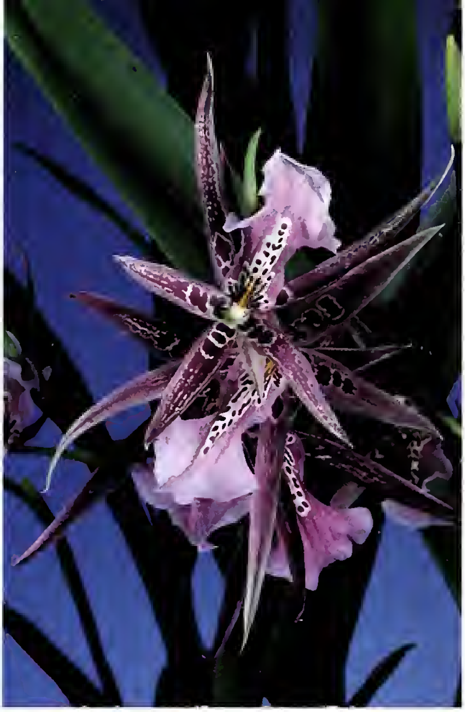
Oncidium sarcodes

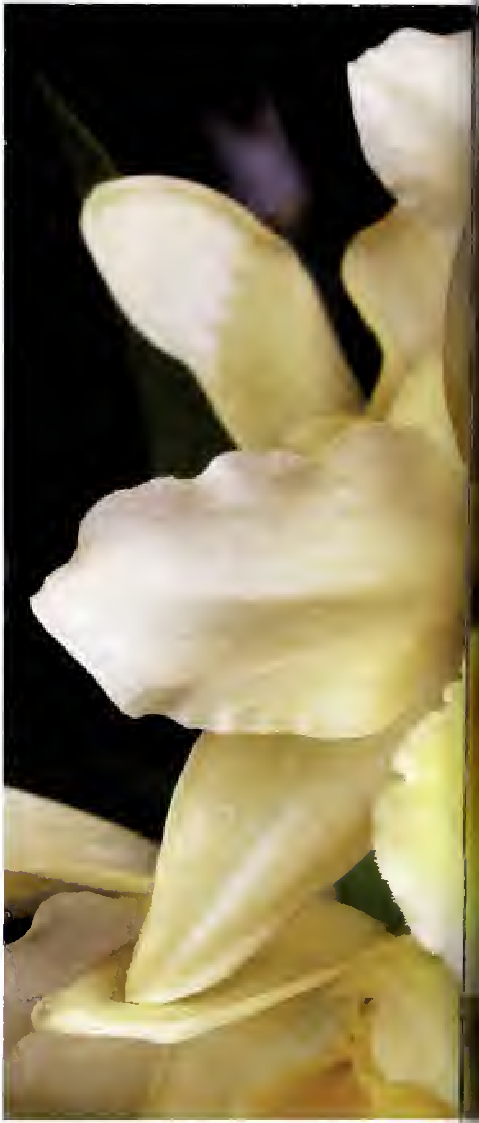
AN ORCHID GALLERY

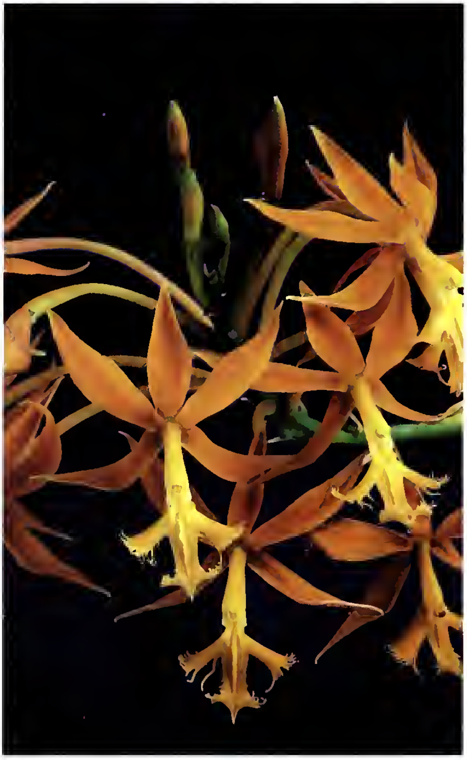
Charles Marden Fitch

Showy cattleyas, paphiopedilums, and cymbidiums are the best known orchids in temperature-climate collections but many more genera are equally suitable for the home grower. This photo gallery illustrates some of the most charming available types.

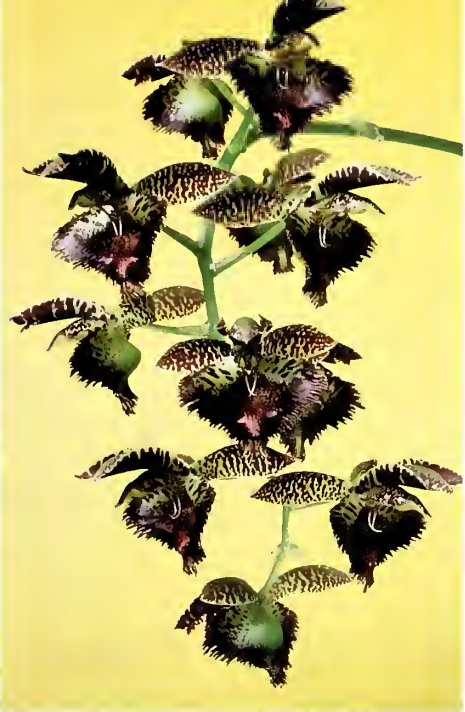
Remember that hybrids, even those primary types (between two pure species), are usually more adaptable to variations in culture and environment than species. Most hybrids are thus easier to grow than most pure species.



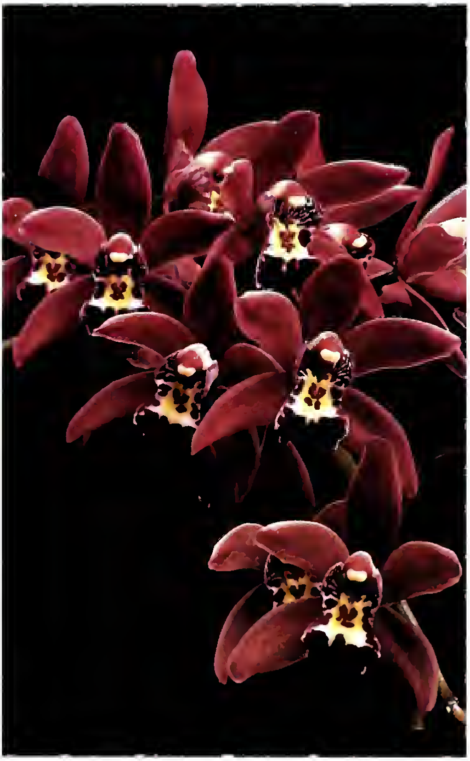




Miltassia 'Dark Monarch' (*Miltonia* x *Brassia*), top, left. Above, *Dendrobium* Golden Blossom 'Venus'. At left, *Epidendrum cinnabarinum*.



Above, right, *Catasetum* Francis Nelson. *Cymbidium* Red Imp 'Red Tower', right.



MINIATURE CATTLEYAS

FRANK FORDYCE

What is a miniature cattleya? Presently the major hybridizers of miniature cattleya-types have established their own guidelines of what constitutes a miniature. My guidelines, published by the American Orchid Society Bulletin of March 1983, allocate miniatures to three plant size groups. The micro-miniature, plants of 3-4" in height (measuring from rhizome to average leaf height); the miniature, plants 5-10" tall; and the compact, plants 10-12" tall.

The micro-mini group is currently dominated by such species as the entire *Sophronitis* group, several tiny laelias such as *L. lilliputana, L. bradeii, L. lundii, L. pumila*, and others including *Epidendrum conopseum*. Few hybrids to date retain the small stature because, when bred with more full-formed flowers of the *Sophrolaeliocattleya* group, plant size increases. *Sophronitis cernua* hybrids usually do remain small but are very difficult to hybridize. Certainly the micro-minis will find wide acceptance with windowsill and "under lights" growers in apartments.

The true miniature group contains species such as *Laelia sincorana, L. milleri, L. flava, Cattleya walkeriana, C. aclandiae, Broughtonia sanguinea*, and *Epidendrum tampense (Encyclia tampensis)*. Hybrids such as *Sophrolaelia* Psyche, *Slc.* Yellow Doll, *Sophrocattleya* Doris, *Slc.* Brillig, *Slc.* Ginny Champion, *Cattletonia* Keith Roth, and others are being registered monthly.

FRANK FORDYCE *and his wife Madge, pioneers in the hybridization and popularization of the miniature cattleya alliance, are owners of Fordyce Orchids, Dublin, California. A lecturer, hybridizer, and author of numerous articles for orchid publications.*

Compacts encompass the major popular hybrids, with foliage 10-12" tall. The majority of these hybrids have more closely linked bulbs on the rhizome than the large-flowered standard cattleyas and do not outgrow the pot as rapidly. A much higher percentage of award type, full formed, brightly colored hybrids are found in the compact group. Such famous names as *Slc.* Hazel Boyd, *Slc.* Madge Fordyce, *Slc.* Sparkle Fire, *Slc.* Dixie Jewels, and *Slc.* Pixie Pearls are highly sought after by hobbyists. Generally the blooms of these round-petaled hybrids are long-lasting (some up to two months), many bloom twice a year, with a wide range of colors embracing red, orange, yellow, purple, and a few whites. Most can be grown as blooming-size adult plants in pots of 5" diameter. For comparison, the standard, large flower type *Cattleya*, *Brassocattleya*, and *Laeliocattleya* adult plants are grown in 6-8" pots with foliage 14-24" tall.

Scores of new intergeneric hybrids of miniatures are now beginning to appear producing cattleyalike flowers on dwarf-sized plants. These are tailor-made for a grower with little space, such as New York City apartment dwellers; I've seen as many as six hundred orchid plants in in a small apartment.

Miniature cattleyas are among the most exciting new orchid trends today for the hobbyist and home grower alike. If you have ever wished you had something uniquely different to contribute to a conversation, try growing miniature cattleyas; even the most blase will stop and listen. ♥

Orchids under broad-spectrum lights in a New York City apartment.

GROWING ORCHIDS IN A NEW YORK CITY APARTMENT

Arnie Linsman

When I tell people that I grow almost 600 orchids in a New York City apartment, they usually just stare at me in disbelief and ask, "How?" Generally my response is, "Easily." But that's not quite the truth. It is something of a challenge, but there's no doubt anyone—and I mean anyone—can grow orchids almost anywhere; getting them to bloom is an entirely different matter. By and large, those lucky folks who have greenhouses have a somewhat easier time. After all, they have almost completely controlled environments. Perhaps the one major difference in favor of the in-the-home orchidist who grows under lights is that he can provide as much daily "sunshine" as he wishes for his plants.

Starting Up

Before embarking on the highly infectious disease of growing orchids in a New York City apartment, there are certain decisions that must be made. First and foremost the grower must answer the question: Who really lives in the apartment—the person paying the rent or the plants? If you plan to lead a normal life in your apartment once you have started growing orchids, forget it. Somehow the plants can take over your life, your space, and your social activities.

Another question is, How am I going to grow—under lights, on windowsills, or a combination of both? There really is no "best" way. If you have great expanses of windows, especially those facing south, and they are not smack up against another building, windowsills may be best for you. But you don't have to despair if you have only north-facing windows. Your orchids can thrive there if you are selective in the choice of plants. However, if you're like me and want to grow all kinds of orchids, you can always supplement the north light by hanging lights above the plants in the window.

Another question—Should I believe everything I read in books about growing orchids? Yes and no. Most books give the apartment grower indications of a plant's natural conditions in the wild. However, most books on orchids, no matter what the title may lead you to believe, are designed for people who grow orchids at home *in a greenhouse*. And unless you are willing to turn your precious apartment rooms into a greenhouse, you really have to learn and devise methods of your own to approximate the specific native habitats of orchids.

ARNOLD (ARNIE) LINSMAN *has grown orchids in his Manhattan apartment for almost ten years; president of the Greater New York Orchid Society and a director of the Eastern Orchid Congress. Also general chairman of the Greater New York Orchid Show.*

Perhaps the most extreme case regarding growing orchids in a New York apartment is that of a man who converted the elegant living room of his posh Park Avenue co-op into what may have been the ultimate space for indoor growing, complete with huge sodium lights, a stainless steel potting sink, humidifiers, air conditioners, fans, and specially lined floors and walls. Of course it cost a fortune, but his plants garnered plenty of American Orchid Society awards because they grew and flowered so beautifully. Sad to say, this fabulous setup no longer exists; the man opted for an honest-to-goodness greenhouse and moved himself and his thousands of plants to California.

Making Adjustments

So the books can give you the basics, but the truth is that you must figure out the best way to grow your plants for your particular conditions, and that takes some time and effort. Among other things, you will suddenly find yourself becoming an amateur plumber, carpenter, and electrician.

When I first started growing orchids, I devoured the books and pored over the photos and drawings, finding most indoor orchid setups somewhat untidy, disorganized, even a bit hazardous. Being reasonably pleased with the look and style of my apartment, I vowed never to have plants all over the place with fans and lights and snaking electrical wires. My apartment, I said to myself, is my home and is going to stay attractive, comfortable, neat, and organized.

Was I mistaken.

It didn't take long for me to develop a serious case of orchid fever, and while the apartment still looks okay (just okay), it has all the ailments I had so assiduously tried to avoid.

There are, of course, ways to avoid a lot of the "appearance pitfalls." One Manhattan grower has a wall of orchids—shelves of plants with lights above. He can close off the entire growing area by drawing vertical metal shades across the wall. It's very neat and precise, just the way I wanted things to be, but frankly, my hobby just grew like Topsy, and the plants and their needs have taken over. Lest anyone think I'm sorry, I'm not!

Since I grow both on windowsills and under lights, I have different arrangements for the different areas, some of which might strike a novice or nongrower as bizarre. The fact that almost al orchids need light, air movement, controlled variable temperature, water, and humidity in various combinations can lead the home orchid grower to strange solutions. The books—including this one—all have suggestions for achieving reasonable humidity levels; the mos widely used is the pebble and water tray My windowsill pebble trays are, for the most part, dimestore plastic drawer dividers; some have pebbles in them, oth ers not, but all are filled with water and surmounted with rubberized sink rack or plastic egg crating which hold the pots. In some windows I have a single shelf holding the trays, in others there are as many as three shelves. In almos every window (I now have plants in ever room, except one bathroom), there ar supplemental lights, some incandescent some fluorescent. All are on timers, se for fourteen to sixteen hours, dependin on the time of year.

In addition, there are a pair of three shelf light cases in what once was a rathe pleasant dining room. Shelves and wate trays in the cases are mounted at diffe ent heights to accommodate varyin plant sizes with fluorescent tubes above And then there are the fans, all over th place, all sizes and shapes, and all opera ing twenty-four hours a day. In th dining room are two oscillating fans wit the two light cases. The dining room window is recessed and has three shelves. A clear plastic roll-up shade can completely enclose the recessed area, providing a contained environment. In the window are two small muffin fans which are "aimed" at the window to "bounce" air movement back at the plants, rather than blow directly at them. Even during the summer months when the window is open, the fans still operate.

Off the dining room is a small bathroom which is tiled, thus providing a somewhat cooler atmosphere. Two shelves in the small bathroom window have fluorescent tubes and a fan. This area has caused more comment by visitors than any other, because for the longest time I chose not to have the constantly-flushing toilet repaired, believing that in its broken state the toilet provided additional humidity to the plants. Now it has been fixed, and I've noticed no change in the plants.

The living room windows provide almost twelve feet of sill space with a wide-open northern exposure. Plants are on water trays, with two large humidifiers below. There also is a brass rod suspended by chains from the high ceiling which provides space for hanging plants and gives a junglelike appearance to an otherwise formal room.

Even the Kitchen

It is in the kitchen that I have had the most fun. The recessed window faces east and has two shelves of plants with an air conditioner below. On top of the refrigerator which is adjacent to the window, is a cool mist humidifier with two fans behind it. One fan is stationary, the other oscillating, gently blowing the mist over the plants, all of which are cool growing. Apparently this system works, since masdevallias bloomed profusely this summer instead of contributing to the usual hot weather funeral services for these types of plants. Of course, I must admit I do not use the oven from April to November, a drawback of sorts, I guess.

There is, in my opinion, no absolute way to grow orchids in the home. Every one I know who grows orchids in the city has a different method or combination of methods to accommodate his or her particular growing locations. Yes, paphiopedilum and phalaenopsis are the easiest of the orchids to grow on windowsills or under lights, yet I know people who grow and bloom vandas with their very high light requirements, odontoglossums with their cool, moist night needs, noble dendrobiums with their light and temperature demands and other orchid genera that greenhouse people say cannot be grown in the home. Yes, it is hard to get a definite, large temperature drop during Manhattan's summer nights without resorting to massive shots of air conditioning (which, of course, dries the air too much), but misting and more fans can help.

Everyone has special tricks for meeting the needs of the plants. They are developed after some trial and error, and since most orchids are both hardy and smart, they tell you if they are happy or unhappy. It's then up to you.

Growing orchids in a city apartment is not difficult; it also is not an easy, passive hobby. You have to work at it. Each of my plants goes to the kitchen sink for watering on a reasonably regular schedule. That takes time, but it also allows me the opportunity to check each plant and its condition, something most greenhouse growers can't do.

Aside from teaching you patience (a virtue in itself in a non-patient city like New York) growing orchids is a relaxing and pleasurable hobby. The challenge is definitely there; the challenge is fun; and the satisfaction of having met the challenge and been rewarded with beautiful and exotic flowers is worth it all.

GREENHOUSE ORCHID CULTURE

Lawrence H. Clouser and Michael S. Owen

Orchids are a diverse family whose members live in many habitats. In temperate regions, a greenhouse is ideal for protecting countless species and hybrids of tropical and subtropical types that will not tolerate winter conditions. Most of these are epiphytic, meaning that in nature they grow on trees and rocks instead of in soil. Some orchids can be found near sea level and others high in the mountains. There are those that live in rainforests and others in drier regions. As greenhouse growers, we must choose plants that suit our conditions, or create an environment to suit the plants we choose to grow. We must meet basic cultural requirements, such as temperature, light, and humidity, and understand how they interact.

Temperature

Temperature is one of the major factors in greenhouse orchid culture. It is generally accepted among growers that tropical orchids will do well in one of three temperature ranges. They are referred to simply as cool, intermediate, and warm. Some growers choose to concentrate on groups of plants from only one temperature range; others prefe some plants from all three ranges. Even in a single greenhouse, we can often find niches or micro-climates that will enable us to grow plants from different ranges The ideal situation, however, is to have definite temperature zones. It is important to note that regardless of the range a day-to-night temperature differentia must be provided, with the day temperature rising 5 to 10 degrees F above the

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Lawrence H. Clouser and Michael S. Owen, *Longwood Gardens, Kennett Square, Philadelphia. They maintain the orchid collection which contains approximately six thousand plants in six greenhouses, including a display area where up to 450 orchids are used at any one time.*

A home greenhouse quickly fills with orchids.

night temperature. This is necessary for proper flower bud formation.

In the cool section, the optimum temperature should be 50 to 55 degrees F at night and 60 to 70 degrees F in the day. It is often impossible and quite expensive to maintain these temperatures in the summer, but winter heating bills will be less than that of a warmer section. Many growers use some form of evaporative cooling. The efficiency of these systems is directly proportional to the relative humidity as they do not work as well when the humidity is high. Some growers use compressor-type air conditioning. This is costly and steps must be taken to compensate for humidity loss.

After considering the dilemma of cooling, many people choose to steer clear of the cool section group. Beginners first should try plants from other groups, to avoid discouragement. There are many beautiful and rewarding plants in the cool section (see the table on page 58 with examples of plants and their temperature requirements). Please note that some plants are listed as belonging to more than one section; different species in the same genus may have different requirements. Also, some plants may be on the borderline of two ranges and might tolerate either one.

The intermediate section will support the broadest range of tropical orchids and its requirements are the most easily met. Ideally, the minimum night temperature should be 60 degrees although an occasional dip to 55 degrees would be tolerated. Daytime temperatures should be 65 to 75 degrees. During summer's hottest weather, these temperatures are nearly impossible to sustain. Orchids with intermediate requirements, however, will usually tolerate these extremes. Some growers still prefer to utilize evaporative cooling to lessen plant stress

EXAMPLES OF PLANTS FOR VARIOUS GREENHOUSE TEMPERATURE RANGES

COOL	INTERMEDIATE	WARM
Anguloa	Ascocenda	Angraecum
Cymbidium	Catasetum	Ascocenda
Dendrobium (Nobile types)	Cattleya	Doritis
Lycaste	Dendrobium	Phalaenopsis
Odontoglossum	Epidendrum	Vanda
Masdevallia	Oncidium	Vanilla
Miltonia	Paphiopedilum	
Paphiopedilum	Vanda	

during this time.

The warm section, like the cool section, is a luxury to some growers. With temperature requirements of 65 degrees night and 75 to 85 degrees day, heating bills will, of course, be higher. If possible, the warm section should be the closest to the source of heat, shielded the most from the wind, and the best insulated of all the greenhouses.

Humidity

For optimum growth, orchids require a relative humidity of 40 to 70 percent, depending on the temperature of the greenhouse. A general rule of thumb is that the higher the temperature, the higher the humidity. Quite often, we must raise the humidity to these levels, especially on sunny, dry days. The simplest method is to wet down the walks and areas under benches and to syringe the plants. Mechanical humidifiers are available and can be connected to a water supply and a humidistat to achieve a more constant humidity level.

Care should be taken when certain climatic conditions exist. On overcast days, for example, supplemental humidity would not be recommended because there would not be ample time for drying before night, when humidity rises naturally, and diseases can proliferate in overly-damp conditions.

Light

In their natural habitat, orchids may be found growing in a wide variety of light situations. Some epiphytes are found in treetops exposed to very high light intensity, while others grow under dense canopies with very little light passing through. A greenhouse can duplicate these conditions for a wide variety of orchids. Vandas and ascocendas, for instance, have high light intensity requirements and can be hung high in the greenhouse, close to the glass. Paphiopedilums, on the other hand, will grow and flower very well with much less light and can be grown on benches, in shadier situations under the hanging plants. How do we know if a plant is receiving too much or too little light? With intense light the leaves will become bleached and large areas will turn brown and dry. Conversely, if a plant has a very dark green color and does not flower well, it probably is not receiving sufficient light. Ideally, orchid foliage should be light green. Consult reference material for recommendations regarding the specific light requirements for individual plants. Light intensities are generally measured in foot-candles. You can purchase a relatively inexpensive light meter capable of measuring footcandles.

Most orchids will grow well and flower within a range of 1,500 to 4,000 foot-candles. Outdoor light intensities can reach 10,000 footcandles on a sunny summer day and the need for shading becomes obvious, usually from mid-spring through mid-autumn. The most inexpensive shadings are liquid preparations that can be sprayed or painted onto the glass or other glazing material. An advantage with this process is the ability to regulate the amount of shade desired by the amount of material applied. It is usually necessary to manually remove this shading in the fall when natural light is less intense. Another type of shading material is woven plastic mesh which is available in various densities and rated by percentage of actual shade. Finally, there are slat shades made of wood or metal. The best application of this form employs rope and pulleys which enable the grower to raise or lower the shades as outside light conditions change.

Regardless of the shading method used, we must block out 40 to 60 percent of the natural summer sunlight to avoid burning orchids in the greenhouse.

Water

As orchids are very diverse, so are their water requirements. Paphiopedilums and phalaenopsis require much more water than cattleyas, although all three need to be watered regularly throughout the year. On the other hand, catasetums, calanthes, and some dendrobiums require an abundance of water for part of the year and absolutely none for the few months they are dormant. Consult references or growers to find out more about particular plants.

Secondly, consider the environmental factors. As temperature and light intensity rise and humidity falls, the need for water increases; the opposite is also true.

Another factor affecting water requirements is the type of container and growing medium used. Plants in clay pots will need water more often than those in plastic. Small pots dry faster than large pots. Finer-grade mixes retain moisture longer than coarse grades. Plants growing on slabs of cork or tree fern need water more frequently than any of the above, possibly every day.

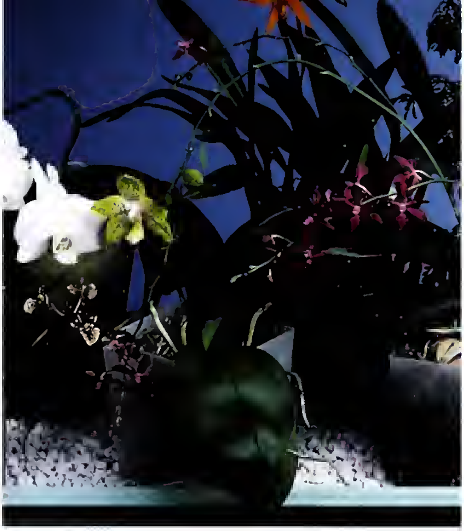
Regardless of the frequency, watering should be thorough. Be sure to soak aerial roots as well as those in the pot. Water as early as possible on bright days as this permits plants to dry off before nightfall. Extra care should be given to plants near heating pipes or ducts, or in the draft of a fan. They will dry out extremely fast.

Problems with water quality occasionally arise. Many well waters are very good for orchids and may even contain trace elements. Other well waters may contain toxic compounds such as sodium, zinc, and boron. Watch new root development for an indication of unfit water. Roots will burn and deteriorate when water is unsuitable. Avoid standard household water softeners since they add too much sodium to the water. In any case, seek professional analysis and advice if water purity becomes a problem.

Other Considerations

After meeting the above basic requirements, other fundamentals that may affect success or failure must be mentioned. It is important to realize that orchids do not like stagnant air. Fresh air should be brought into the greenhouse when the weather permits. Even in the winter, many growers will "crack" a vent for a few hours a day to allow some air exchange. Do not allow cold drafts directly on plants. More important than fresh air is providing gentle air movement. This can be achieved with fans. Exhaust fans help in warmer weather as they help remove heat from the greenhouse as well as provide air movement.

Repotting is eventually necessary whether to rid a plant of decomposing mix or simply to reduce it to a reasonable size. The idea of pulling a plant out of its container and cutting it up may be frightening to the novice, but it must be done. Much has been written on potting mixes, containers, and potting methods. If you have never attempted to repot an orchid, read as much as you can on the matter. A visit to another grower for a

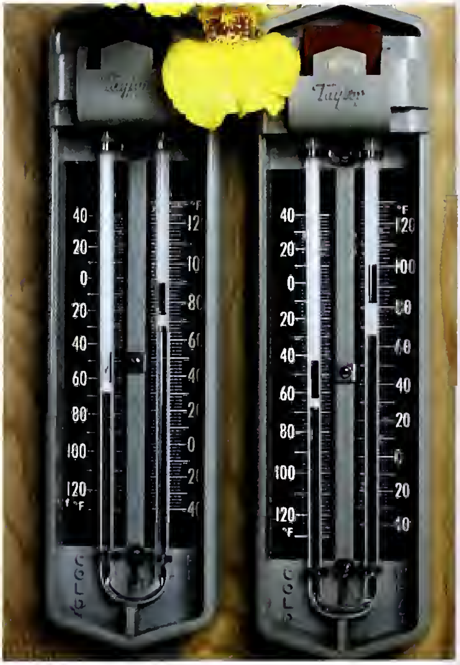


Trays of gravel kept moist increase the humidity for orchids.

demonstration might be the most informative and reassuring means. Remember that the proper time to repot is, in most cases, after flowering and just before or as new growth develops. Many different potting medium choices exist and even though their properties differ slightly, all are easy to work with. Properties of containers vary, and watering must be adjusted accordingly. The most important factor concerning containers is complete drainage. Slab culture, where plants are attached to and grown on cork or tree fern sections, yields the best drainage but frequency of watering must be increased.

As a rule, orchids do not require a lot of fertilizer. Many epiphytic orchids receive minimal amounts of nutrients in their native habitat. How much and how often to fertilize depends largely on stage of growth. An actively growing plant should be fertilized more often than one that has completed its growth, is in flower, or is dormant. Sometimes overfertilization will cause an orchid to put on additional vegetative growth instead of flowering. When in active growth feeding a balanced soluble fertilizer at one-half recommended strength every three or four weeks will suffice. Some growers feel that a high nitrogen fertilizer should be used when plants are potted in a fir bark mix. Slow release fertilizers are also available and can be incorporated into the potting mix or used as a top dressing. A high phosphorus fertilizer may be used to encourage flowering after a plant has completed its growth cycle. This can enhance flower production and quality.

As with any form of gardening, greenhouse orchid growing takes a little time and application. The rewards are directly proportional to the investment. If you are concerned about improvement, read more! Join orchid societies and subscribe to periodicals. Visit the library. Keep good records, as they are a library in themselves. Visit botanical gardens and orchid dealers. With all this help, orchids are not really that hard to grow.



A maximum-minimum thermometer helps chart growing temperatures.

This tree, in the dry region of El Salvador, supports three popular species of orchids.

GROWING ORCHIDS IN THE TROPICS

Carl L. Withner

As orchid lovers soon learn, reproducing natural growing conditions in the home or greenhouse can be a tricky proposition. There seem to be orchid "weeds" that will grow and flower for all without any special care. Others couldn't be more finicky and require a set routine with great attention to detail. A knowledge of such differences and an eye for the intricacies relate to the great variety of environmental niches in nature in which these exciting plants can grow, flower, be pollinated, and produce seed for new generations.

It is amazing how well orchids can grow in cultivation; success with orchids is a testimony to their tolerance and adaptability and of the ingenuity of the growers to provide favorable growing conditions in a variety of climates. A closer look at orchid habitats around the world will give a better perspective on what we are trying to do in the temperate zone, and how we manage to grow so many kinds of orchids side-by-side.

Cultivating orchids in the tropics requires the same attention to detail as in more northern locales. The growth requirements of a given plant remain the same; it's just that they must be provided against a different background of environmental conditions from that of a usual greenhouse, windowsill, or underlight culture. The best green-thumb secret of all is to choose only plants that will grow and flower well in your specific surroundings. Temperature/humidity relationships are of paramount importance, especially in the sea-level locations where many of us live.

Habitats

In the tropics and subtropics most desirable orchids seem to originate in mountainous areas, with relatively high humidity and a 15-20 degrees F drop in night temperature. In the American tropics most cattleyas, certain laelias, many oncidiums, and any number of miscellaneous species come from a moderate altitude, up to 3,000 or 4,000 feet. In Asian tropics we would find many dendrobiums, the green-leafed paphiopedilums, coelogynes, the blue *Vanda coerulea,* and a host of bulbophyllums, calanthes, and still other species. Days are sunny and nights are often cool and damp after the clouds settle down in the evening over the valleys and mountain tops; rainfall may be seasonal. Orchids growing under these conditions are so-called "intermediate" orchids and require a temperature of 60-65 degrees F at night with warmer days. Humidity requirements run from 50-70 percent.

At sea level, on the other hand, especially near the Equator and between the Tropic of Cancer and the Tropic of Capricorn, we find more sun, more heat, and more humidity, with night temperatures about equal to days and little seasonal change. Orchids growing in these locations still prefer a temperature differential, though it need not be so great. A slight cooling at night will promote flowering in plants such as phalaenopsis (the moth orchids from Southeast Asia), in the cane-type dendrobiums and their innumerable relatives and in the tesselated-leafed paphiopedilums. Many vandas and their cousins the arandas, renantheras, and ascocentrums, and all their various intergeneric combinations, prefer equatorial conditions, forming large showy outdoor beds of flowers so spectacular to the tourists in Hawaii, Singapore, or Bangkok. There are no particular American orchids in this "warm" category. Almost all come from Asian areas where they are the most common. The most prodigious of all orchids, the gramatophyllums, are Asian and may reach a height of more than 15 feet in clumps 8-10 feet or more in diameter. Some cane dendrobiums will reach 8-9 feet, and a renanthera I saw was more than 12 feet high. Cattleyas and their relatives do poorly under such conditions though that is not sufficient reason fo people not to try to grow them in the lowland tropics.

At the cool end of the spectrum, the American tropics come to the fore particularly with odontoglossums, oncidiums, miltonias, masdevallias, the lycaste and their cousins, the anguloas. These plants are found in mountainous area from Mexico and Central America south through the Andes growing at altitude up to 8,000 or 9,000 feet and sometime higher. In Asia cool orchids are best represented by the genus Cymbidium with many species and even more hybrids There are also numerous dendrobiums coelogynes, and other rare plants from areas such as the high mountains and cloud forests of Madagascar or Papu New Guinea—areas extremely rich in orchids. I'm always envious of our friend in Guatemala City, in the "Land of Eternal Spring." There the climate, at a mile or more high, is suitable for growing both intermediate and cool orchids, with few accommodations necessary to produce fine plants. The orchids usually reflect these ideal conditions by attaining specimen size and producing innumerable flowers compared with what can be expected in a northern greenhouse — even one with air circulators, evaporative coolers, and all the other expensive paraphernalia designed to provide a "natural" environment.

Tropical Travels

One is always carried away by the apparent ease with which orchids are grown in the tropics, and the temptation to bring them home alive is great. Even considering the possibility of furnishing proper greenhouse or home-growing care, we must fight down the urge to collect! True, people have brought plants home successfully in past years and grown them to perfection, but today it is more sensible to obtain locally grown plants.

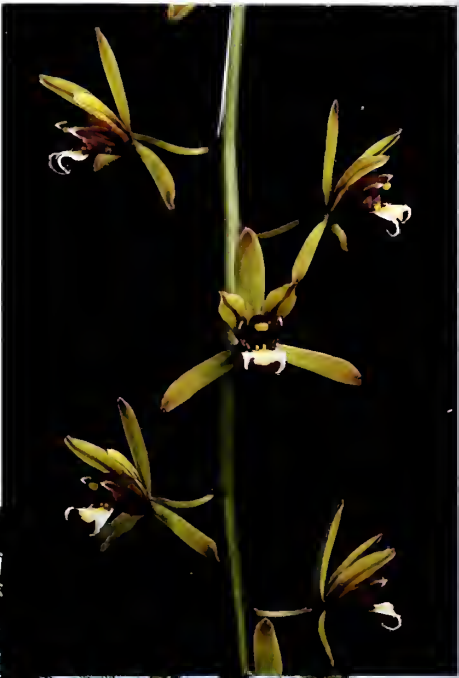
Assuming that you have already made arrangements for a vehicle that can traverse tropical roads, have scouted suitable locations with a knowledgeable local collector and have provided for your safety in a variety of ways, you must still obtain that most important document, the CITES (an acronym for Convention on International Trade in Endangered Species) permit, or you will not be allowed to bring the plants into the United States.

Many orchids, as well as other plants, are on the Endangered Species List. Such plants cannot be imported into the U.S. without a CITES permit. More than thirty countries belong to this convention, and even if the country of origin does not belong, the U.S. still requires the permit. Obtaining permits is time consuming, frustrating, and often just about impossible for the ordinary traveler. All of this assumes that you have already obtained your own import permit from the U.S. Department of Agriculture before you ever start on your trip. Locally grown orchid plants look better all the time!

Also, occasionally, it is possible as an alternative to find a tropical nursery that can obtain permits and ship orchids to you by airmail. That is the most satisfactory solution for obtaining a limited number of plants, *if* there is a nursery available and *if* they are able to ship by airmail. But be prepared for the worst, as mail can be delayed in transit, USDA inspection must occur, and plants are not always in good condition on arrival. In any case, they must be re-established in cultivation. It's not with much surprise to say that locally produced plants are often a better buy!

One final word concerns the conservation of orchids. This has become a problem not only for orchids but for all the forests in the tropics—as one author says, "Extinction is forever!" Many tropical ecosystems are currently threatened, orchids included, and anything we can do to prevent these depredations is to our ultimate benefit. We are still discovering and describing new species of orchids and don't know the pollinators of many species; biochemists are just finding compounds in orchids that may be of pharmaceutical value; we still don't appreciate the complete potential of these fabulous plants or many others. Man will have interfered with or stopped evolution in the orchid family in a few short years if more and more forest systems are destroyed. It is more than frustrating to see logged, mined, or other cleared areas with countless orchids just burned up in the slash, unavailable for rescue. Population pressures seem inexorable in so many situations, and our favorite plants are being diminished, little by little, year by year. It gives us an even greater responsibility as orchid growers to keep these plants alive and in cultivation and to learn as much as we can about them in nature so that we can appreciate them in our travels for as long as we can. ❦

A closeup view of *Cymbidium finlaysonianum*, right. Guest editor Charles Marden Fitch, below, in Thailand, holding a *Cymbidium finlaysonianum* orchid that has been cut from a sugar palm.



MODERN PROPAGATION TECHNIQUES

CHARLES MARDEN FITCH

Please—DO NOT REMOVE THE BOTTLES
Please—DO NOT REMOVE THE BOTTLES

Meristem tissue culture of cymbidiums shown here in a rotator at Stewarts Orchids. Cultures are rotated during the initial stages of propagation.

Your orchid collection probably contains examples of several propagation techniques. Thanks to efficient laboratory procedures rare orchid species, unusual hybrids, and select clones are now sold at reasonable prices. They are propagated by sexual and asexual (vegetative) methods. The most recent advances in techniques involve tissue culture or meristeming, a type of vegetative propagation that produces precise duplicates of the donor clone.

Pure species are efficiently propagated by seed, preferably by crossing two select clones. Superior individual plants can be duplicated with meristem culture. These techniques bring us rare species without threatening wild populations or necessitating hazardous jungle collecting. Outstanding hybrid clones in many genera are propagated by meristem, too, providing unusually fine orchids at moderate prices.

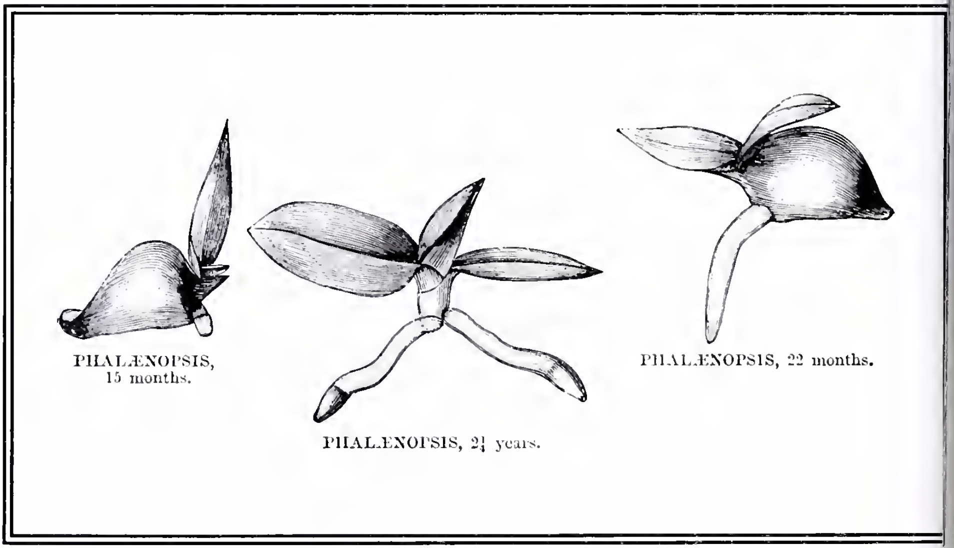
From Seed

For greater variation, with the exciting prospect of flowering something superior at reasonable cost, choose seedlings of new hybrid crossings. Sowing orchid seed is a precise scientific procedure, far improved over old fashioned sprinkling of seed around the base of established potted orchids.

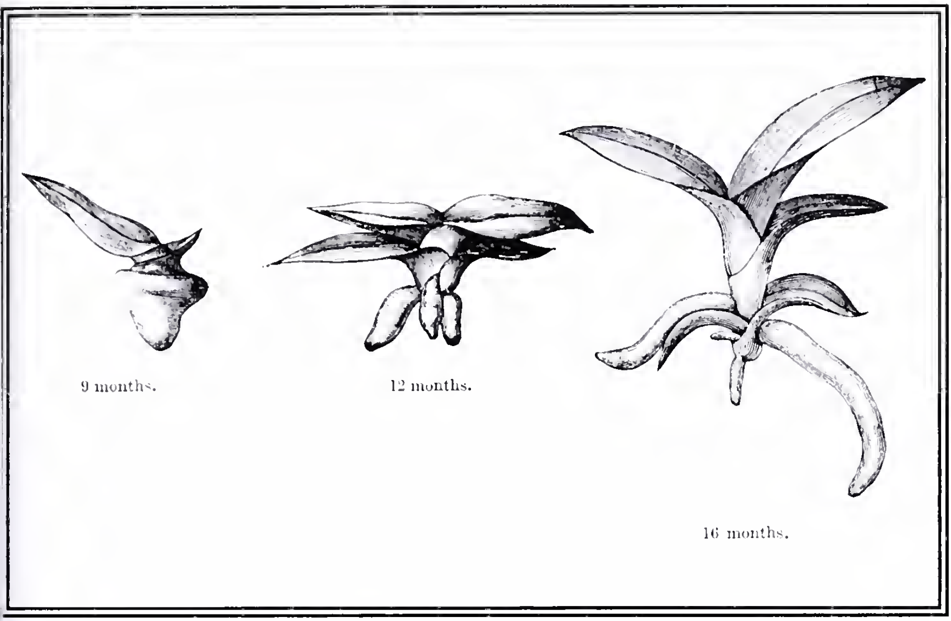
The expert hybridizers and lab technicians know when the fruit (pods) of different genera are most likely to yield viable seed. Picking unripe fruits for green pod sowing allows innovative hybridizers to grow unusual crosses that may not survive if fruits are left to fully mature. Growing orchids from seed is still an important procedure. Through crossing different plants, orchid breeders develop new colors, shapes, vary the season of bloom, work toward improved balance; in short, they manipulate all of the subtle characteristics that go into making a superior orchid.

Vegetative Propagation

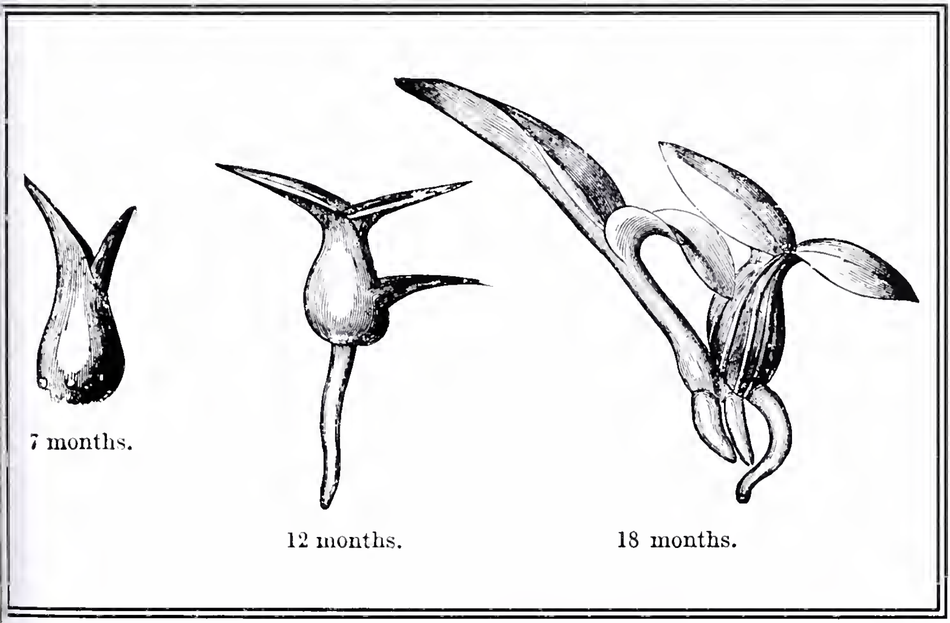
Traditional vegetative propagation the division of plants or waiting for offsets to form, is a slow process resulting in high prices for select divisions. Now modern tissue culture permits commercial growers to propagate thousands of identical plantlets (mericlone plants) from a single individual donor. Growing orchids by tissue culture is similar to seed sowing in that the first few years plants grow on nutrient agar (a seaweed derivative) in glass flasks. ♥


PHALÆNOPSIS, 15 months.
PHALÆNOPSIS, 2¼ years.
PHALÆNOPSIS, 22 months.

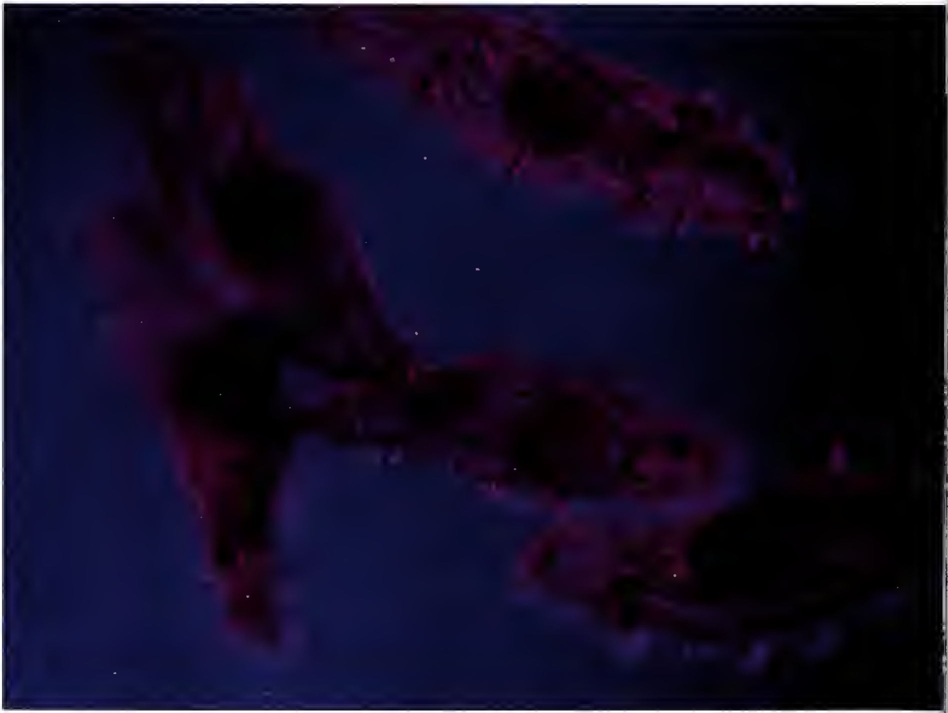
Phalaenopsis seedling at various stages of growth.


9 months.
12 months.
16 months.

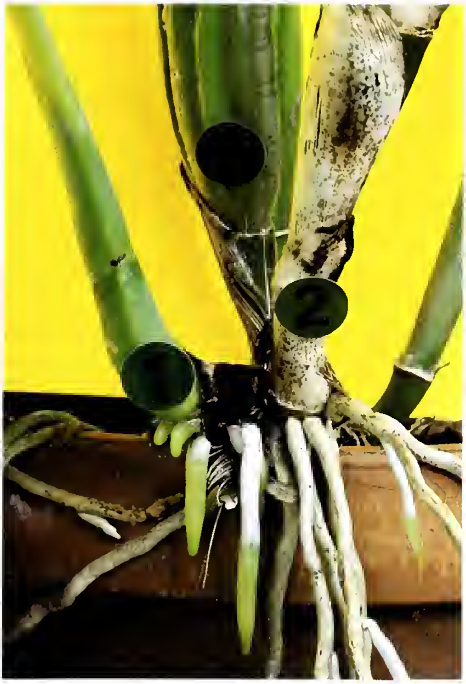
Cattleya seedlings in various stages of growth.


7 months.
12 months.
18 months.

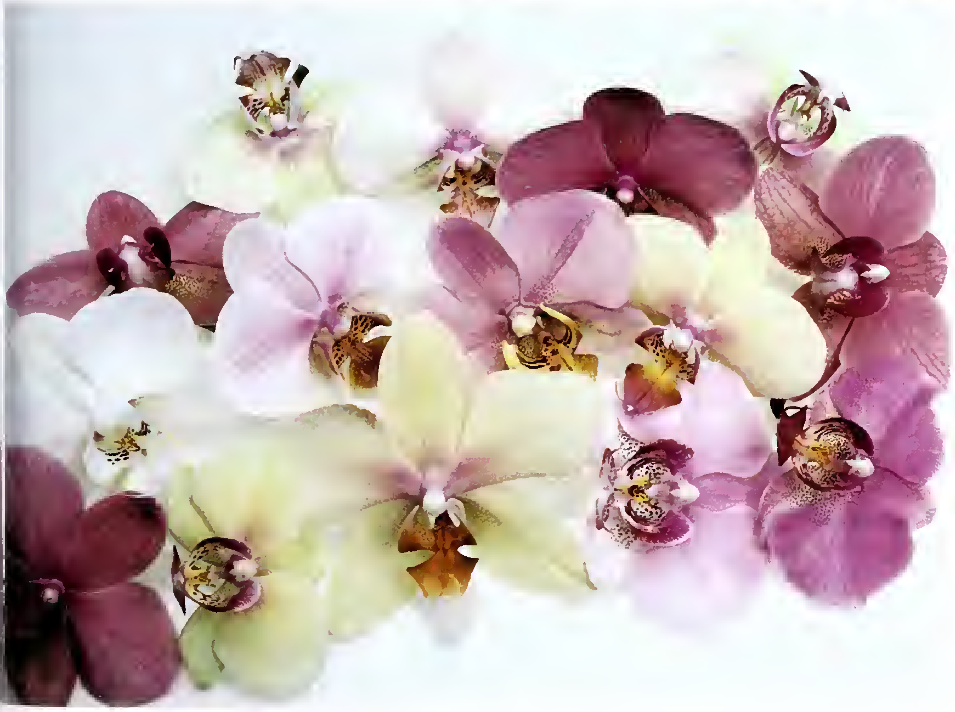
Dendrobium seedlings at various growth stages.



Above, *Catasetum* seed photographed at 400x magnification. Sowing orchid seed is a precise scientific procedure. At left, a ripe seed pod contrasts with a fresh flower of *Brassolaeliocattleya* hybrid.



Cattleya hybrid, right, with new growth (1), and two previous pseudobulbs (2 and 3). New roots are growing over the edge of the pot. The photograph below demonstrates the variation in seedlings produced from parents. There is a great deal of variation in the color and form of the flowers.



RAISING ORCHIDS FROM SEED

JOSEPH ARDITTI

The first description of orchid seedlings was published by the Britist botanist R.A. Salisbury in 1804, more than two thousand years after Theophrastus first described what we today consider to be an orchid plant. The variety of false notions that arose in the intervening years regarding the existence, viability and germinability of orchid seeds was undoubtedly due to their exceedingly small size and peculiar germination requirements. Most orchid seeds measure less than a millimeter in length and from less than a tenth to a quarter of a millimeter in width. (There are about 25-1/2 millimeters in an inch.)

The embryo enclosed within a membranous, but often transparent, seed coat is even smaller and may at times consist of no more than ten cells. In addition, orchid seeds have little or no food reserves and appear to be incapable of normal metabolism during the early stages of germination. Therefore, orchid seeds cannot germinate readily in nature. In order to germinate they must become infected with a fungus which somehow assists with their metabolism and may even provide certain nutrients and growth factors. This fungus eventually penetrates the orchid roots where it remains throughout the life of the plant. It is therefore known as *mycorrhiza*, meaning "root-fungus."

Procedures for orchid seed germination were long unknown in Europe, and for many years growers could replace their stock only through importation or vegetative propagation. However, as orchids increased in popularity during the 19th century, attempts were made to develop practical methods for seed germination and seedling culture. The first successful germination of orchid seeds seems to have been by David Moore, Director of the Glasnevin Botanical Gardens in Ireland. He spread the seeds on or near substratum which supported mature orchid plants. A surgeon in Exeter, England named John Haris suggested hybridization and seed germination to John Dominy of the Veitch nursery. He produced the first orchid hybridization in 1852. For half a century Moore's was the only known method of orchid seed germination.

The biological principles which made this type of germination possible remained unknown for many years, since neither the growers nor the scientists of the day were aware of the role played by mycorrhiza in orchid seed germination. This is surprising, because the orchid mycorrhiza was apparently first noted in 1840, positively recognized by 1846, and its existence firmly established by 1886.

The part played by the fungus in germination was, however, not recognized until 1899. The French botanist Noel Bernard and German orchidologist Hans

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JOSEPH ARDITTI *is a Professor in the Department of Developmental and Cell Biology at the University of California at Irvine. He is the author of several books on orchids.*

Burgeff, using this fungus, developed the symbiotic method for orchid seed germination. This involved the inoculation of culture tubes with both seeds and fungi. Although this method was a great improvement over the previous technique, germination was erratic and the fungus often killed seedlings. Still, the method was widely used since no better one was available.

The discovery which made large-scale orchid seed germination possible, and in effect revolutionized orchid culture, was made in the United States by Dr. Lewis Knudson at Cornell University. Combining his own knowledge of the influence of carbohydrates on green plants with previous discoveries by Doctors Bernard and Burgeff, Dr. Knudson reasoned that orchid seeds should germinate well on an agar medium containing a balanced mixture of minerals and sugar. He tested his theories by experimentation, proved them to be correct and developed the now famous and widely used *asymbiotic* method for seed germination. Following his original discovery, Dr. Knudson continued to investigate the problem and in 1946 published his improved and by now well known "Knudson C" medium. Although generally satisfactory for most genera and species, this medium proved not entirely suitable for *Paphiopedilum (Cypribedium)* seeds. For these a special medium known as "GD(1)" was developed by Detert and Thomale in Germany. A more recently formulated nedium for *Paphiopedilum* by Dr. R. Ernst s more effective.

Seed Germination

The asymbiotic method for orchid seed germination is relatively simple, but it requires care and close attention to details. Basically, it involves sowing the seed under completely aseptic conditions on the prescribed agar medium in a bottle or flask. This is called "flasking."(*) Many orchid hobbyists send their seed to professionals for flasking. When the seedlings become crowded, they are thinned by *transflasking*. When they become so large that they crowd the flask or bottle, it is time to move them to a community pot or flat. This is the point at which most people raising plants from seed acquire their orchid seedlings.

Preparing the Community Pots

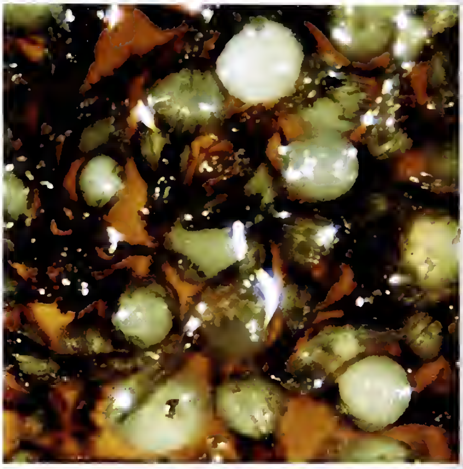
A variety of methods and culture media have been employed by various growers. A simple method which was used successfully by Ilsley Orchids of Los Angeles is to fill a 5-inch pot with coarse fir bark or broken clay pots to within 1-1/2-2 inches from the top. This insures good drainage. Each pot is then filled to its rim with a well mixed, thoroughly moistened, firmly tamped compost consisting of the following:

seedling grade, heat-treated, kiln dried fir bark	80-90% by volume
shredded redwood bark or redwood shavings	10-20% by volume
Dolomitic limestone	a full 4-inch pot per 2 cu. ft.
hoof and horn meal	the same

Removal and Preparation of Seedlings

Soften the agar by placing the bottles in body-temperature water for 30-60 minutes. The seedlings can then be easily pulled out with a wire loop. If they are

Paphiopedilum rothschildianum germinating seeds.



Paphiopedilum rothschildianum protocorms.

too big, break the bottles. Soak or wash the seedlings in lukewarm water until *all* the agar has been removed. This should be followed by a rinse in a good anti-damp agent (a fungicide) according to the instructions on the package.

Planting the Seedlings

Make a deep hole with a stick about the diameter of a pencil, carefully insert the seedling in it and firm the compost around all the roots. Allow about 1-1/2-2 square inches per seedling, and there probably will be no need to repeat until they reach 6 inches in height.

Growing the Seedlings

Place the community pots in a corner of the greenhouse where the light intensity is about 1,000 foot candles. Day temperatures should be about 75 degrees F but no higher than 90 degrees F, and the night minimum not below 70 degrees F. Relative humidity should be around 70 percent. The young seedlings should be sprayed with a fine mist two or three times a day. Do not water them during the first week. After that, water *carefully*, since over-watering is the most common cause of failure. When young roots appear on the seedlings (usually within two to four weeks), it is time to start fertilizing. Use any of the commercial high-nitrogen soluble fertilizers, either at quarter strength once a week or 1/10 or less strength with every watering. Leach the compost every two to three weeks to prevent build-up of salts. When the seedlings become crowded, it is time to move them to separate pots. Fir bark, Mexican tree fern or Hawaiian hapuu may be used for this purpose. Pack the potting material lightly around the roots, taking care not to damage the roots. Place the pots on a greenhouse bench and treat them as adult plants. Good luck!

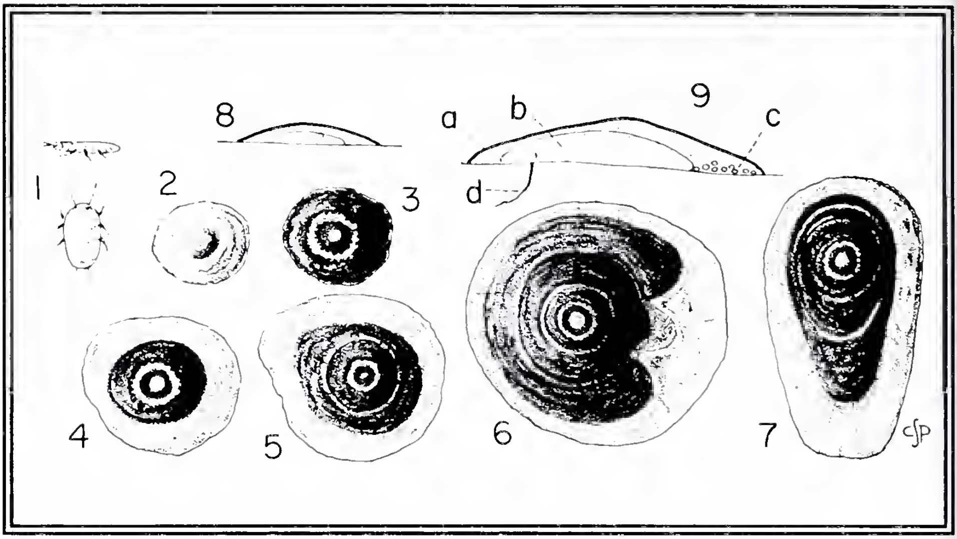
Research support by the American Orchid Society and the Orchid Digest Corporation have made the writing of this possible. I would also like to thank Lynn Maxey and Robert Knauft for their aid in the preparation of the article.

The dorsal sepals of this *Cattleya* hybrid show evidence of air pollution.

CONTROL OF COMMON ORCHID PESTS

Charles Marden Fitch

The usual array of houseplant pests infest orchids. Flower buds are favored by aphids, new growth and roots may be attacked by mealybugs, and scale insects occasionally establish on pseudobulbs. New root tips and tender sprouting inflorescences are eaten by slugs and snails. Spider-mites often gather on thin-leaved orchids but some mites damage even the thicker-leaved phalaenopsis. Beetles and weevils may invade a collection to feast on new leaves or flowers. All of these



Armored or diaspine scale showing 1) newly hatched crawler, 2 to 5) growth stages, 6) mature female, 7) male, 8) longitudinal section of young scale and 9) longitudinal section of mature female showing a) scale covering, b) actual body of scale, c) eggs in space between body and cover and d) mouthparts which penetrate plant.

pests can become serious threats to orchid plant health unless you control them.

General Recommendations

1. Follow pesticide directions. Never mix sprays at concentrations stronger than suggested.

2. Wettable or soluble powders are preferable to emulsified liquid pesticides. The liquid preparations often contain an oil base carrier that may harm some orchids.

3. Apply pesticides thoroughly, but not enough to saturate the root area unless you are using a product specified as a drench for root-dwelling pests.

4. Re-apply the appropriate pesticide a second time in seven to ten days, or as recommended on the package. Most preparations kill adult pests but not the eggs.

5. Inspect newly acquired plants for pests. Isolate new plants for a month, then inspect again for pests. Placing newly acquired plants directly next to other specimens in your collection is a good way to introduce pests.

Pest Controls

Aphids: Wash off exposed insects. Spray orchids with Malathion or Orthene soluble powder (1 teaspoon per gallon of water).

Caterpillars: The biological insecticide made with *Bacillus thuringiensis* is very safe. It is available as Thuricide, Reuter Caterpillar Attack, and other brands. Soluble Orthene powder mixed one teaspoon per gallon of water is also useful.

Mealybugs: Add a few drops of wetting agent per gallon of spray to help insecticide get through waxy covering of these pests. Malathion and Orthene soluble powder are effective.

Mites: Pentac powder and Kelthane are useful miticides. Be sure to get spray on undersides of foliage.

Scale: Diazinon, Malathion, or Orthene soluble powder will kill crawling stages of scale. Add wetting agent and repeat application according to package instructions.

Snails and Slugs: Use safe solid bait pellets around pots. Spray potting mix with metaldehyde snail/slug pesticide or sprinkle granular form on surface of potting mix.

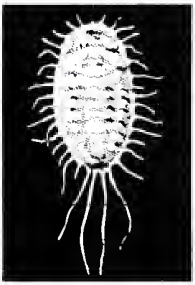
Orchid Diseases

The best way to avoid orchid diseases is to be sure all plants added to your collection are disease-free. Keep your orchids healthy by controlling pests and growing the plants with adequate air circulation and light. Water early in the day so that foliage is dry by nightfall. The lower temperatures at night, coupled with darkness, encourage diseases to start if foliage is wet or water rests in new growth.

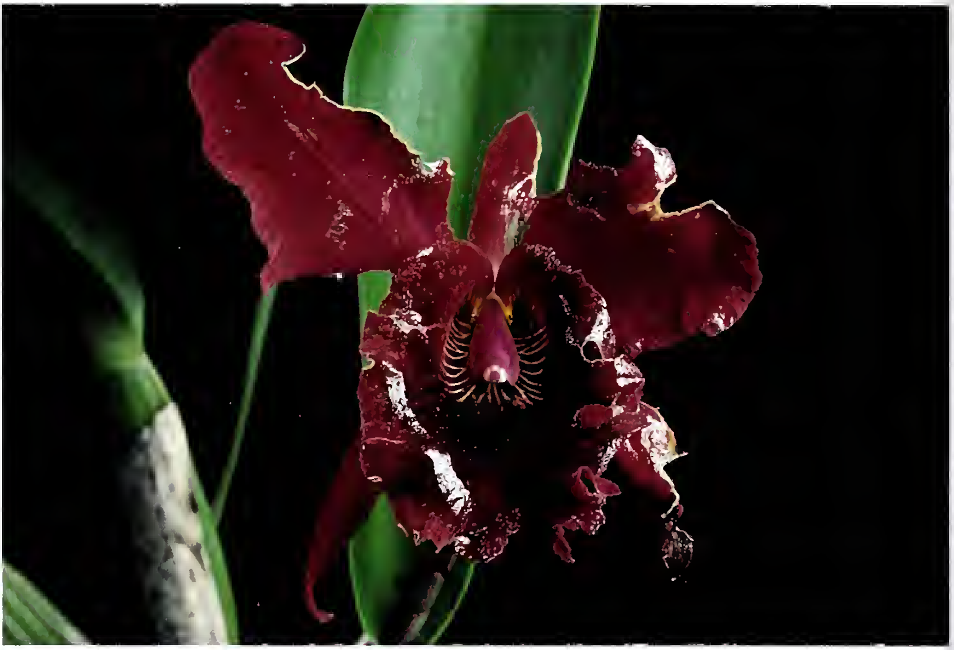
Even with careful cultivation some disease is bound to occur on a few plants. In fact some orchids are more susceptible to bacterial and fungus disease than others. With two different cattleya hybrids grown side by side one may get rot (a *Pythium* or *Phytophthora* fungus attack) while the other remains healthy. If you find that certain clones are prone to disease under the conditions you can provide, consider growing plants that are better adapted to your environment.

Fungus diseases such as black rot (*Phytophthora cactorum* and *Phythium ultimum*) and anthracnose (*Glomerella* sp.) are easy for non-specialists to confuse with bacterial diseases such as brown spot (*Pseudomonas* sp. and *Erwinia* sp.). Both fungus and bacterial diseases may occur in a collection. Fortunately some modern sprays such as Banrot, Natriphrene, and Physan help control both types of diseases.

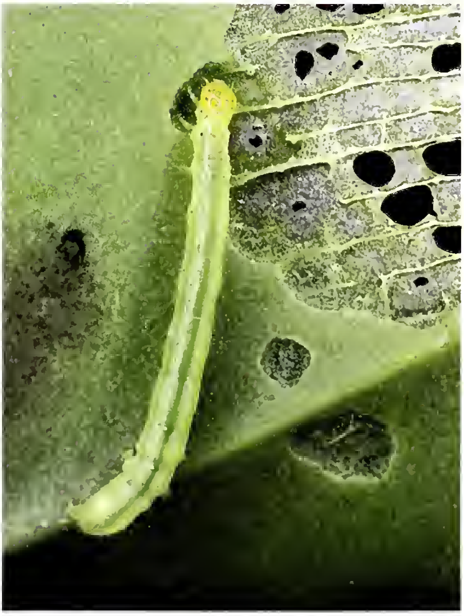
Physan liquid, mixed 1 to 1-1/2 teaspoons per gallon of water is effective in preventing some troublesome bacterial rots that attack seedlings, especially *Phalaenopsis.* Plant pathologist and orchid disease expert, Harry C. Burnett of the Florida Department of Agriculture, recommends a spray of benomyl 50 percent wettable powder (sold as Benlate) at 1 tablespoon per gallon of water to control several common diseases such as anthracnose, leafspot, fusarium wilt, and botrytis petal blight. He also confirms that Physan is useful in preventing damp-off of seedlings just transplanted from flasks, and community-pot sized seedlings when used as a drench every two weeks (1-1/2 teaspoons of Physan per gallon of water). For many illustrations of orchid diseases see the booklet *Orchid Diseases* by Harry C. Burnett, published as Bulletin No. 10 of the Florida Department of Agriculture, a publication available in most botanical garden libraries.



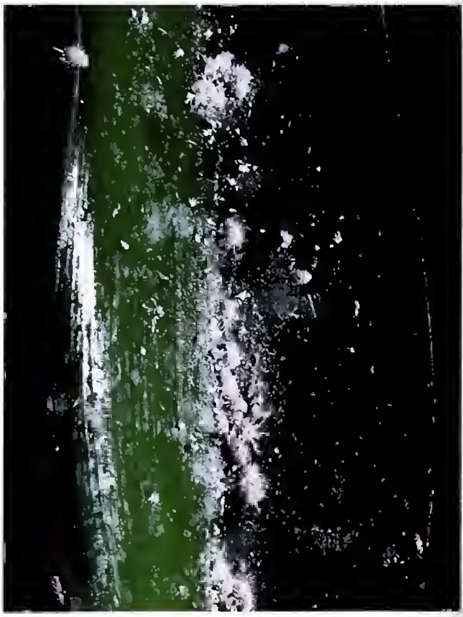
Mealybug



The flower of this *Cattleya* hybrid has been damaged by slugs.



Caterpillar eats the leaf of a *Phalaenopsis* orchid.



Mealybugs infest new growth of this *Cattleya* hybrid.

BENEFITS OF THE AOS AWARDS SYSTEM

Ernest Hetherington

The American Orchid Society national system of awards began in the first years after World War II. Since 1945 the AOS has developed an internationally recognized system to meet the need for a fair method of evaluating orchids. The AOS Awards system is fully detailed in the AOS "Handbook on Judging." How does this awards system benefit the amateur grower?

The Judging System

Even a beginner when selecting an orchid asks, "How does this orchid, which I now have in bloom, compare in quality and other desirable characteris-

American Orchid Society judges study a *Pleurothallis* species at its monthly session.

tics with others of its type?" We could put the question another way: "How do I tell a good orchid from a bad one?" The AOS awards system helps answer these questions.

The AOS system of judging grants awards in several categories. The first category grants recognition to a superior form of an existent type. To illustrate: if you have a purple *Cattleya*, what are the qualities for perfection in that type to look for? Our second judging area is to grant recognition to new orchid hybrids that are not only new but desirably different, or an improvement. Hybridizers are continually inter-crossing a great variety of dissimilar orchids. When a distinctly different orchid comes along, one that also has charm and beauty, it is worthy of recognition. Our third category is to grant recognition to superior forms of species which have been collected from jungles around the world. If we study orchids in nature, we find that even within a given species, not all are alike. Sometimes one particular plant in a group will have flowers that are larger or darker or have certain characteristics that stand out. The Society grants recognition to these plants if shown before an AOS judging panel.

We must mention, in discussing our judging system, that there are two types of judging. Many amateurs are familiar with ribbon awards given at flower shows. These are for the first, second, or third prize at that show. The awards apply only to plants submitted at that show. The AOS system, however, is based upon evaluating that plant in bloom against all others of that basic type which the judges *may have seen*; this requires experience. It is the only fair method of granting recognition. The AOS system was patterned after judging of the Royal Horticultural Society in England which has been granting awards since 1859. Most of the orchids which are grown today are hybrids. They are the work of orchid breeders who create not only new types of orchids but who also improve existing types. The quality of our orchids is constantly improving. Even as they improve, there is no final perfection.

There are over four hundred AOS judges throughout America. A minimum of six years of training; three years as a student judge and three years as a probationary judge, are required before a person is given the title "Accredited AOS Judge." There are eighteen regional judging centers throughout the United States. The American Orchid Society Bulletin lists the location of these judging centers. These comments are intended to place emphasis on how an awards system can be of benefit to you. If there is a judging center near you, attend a session to see how orchids are judged. If you have a plant you think might be worthy of an award, take it in. There is no charge for having it judged. If it gets an award, there is a small clerical charge. When you submit the plant, you will be required to fill out an entry form. The plant is then screened by a panel of judges. If they think it should be judged, it is scored by not fewer than three judges. When we say screened, they collectively look at it. If they think it stands a chance of receiving 75 points, this is the minimum number of points required for an award, they send it to a judging panel.

What is important to you as an amateur is that when a plant receives an award from the American Orchid Society, it keeps that award forever. If it is divided into any number of divisions, every division carries the same name and the award that your plant received. This is why awards are of value to an amateur grower. If you are offered a plant or have the opportunity to buy one at a commercial nursery which has received an award, you know that it has been judged by an impartial panel and the quality of the flower meets certain American Orchid Society standards.

Some Criteria for Judging

In discussing the practical value of an award system, surely the question must be asked, "What do I look for in various orchids to determine their quality?" The major genera grown in the United States are cattleyas and allied hybrids, paphiopedilums (lady slippers), phalaenopsis, cymbidiums, oncidiums, odontoglossums, vandas, and dendrobiums.

In cattleyas, look for good flower qualities. The color must be intense, clear, and rich. The shape should be round and full with flatness and symmetry. If it is a large-flowered type, the flowers should be of good size. What is important, also, is that the flower should be carried well on a good, strong stem. Those cattleyas with small flowers must have the qualities described above except for size of flower.

Phalaenopsis have flowers of white and pink, which can now be expected to have large size and good rich coloring with flowers well carried on a strong stem. White phalaenopsis should have good coloration and substance so that they are not transparent. Striped or spotted phalaenopsis should have rich colors with clear, sharp markings.

In paphiopedilums look for large size, good carriage, and richness of color. The flowers (generally they have one flower to the stem) should be carried erectly on a good, strong stem. There are several basic types—the sort with spotting on the flower parts. The spotting should be clear, distinct, and bold. If it is a flower without spotting, intensity and clearness of coloring are the qualities that separate the average from the superior flower.

Millions of cymbidiums are grown throughout America, in both conventional and miniature types. Look for richness of coloring, size, shape, substance, and arrangement of flowers on the inflorescence. In miniatures, the bottom flower should clear the leaf mass and have two or three sprays of flowers.

The AOS Awards

Let us look at some of the AOS awards so we have a better understanding of what they are. The first is known as the HCC/AOS or Highly Commended Certificate. A minimum of 75 points is required for this award. The point spread for an HCC is from 75 to 79.5. The next award in ascending order is the Award of Merit, AM/AOS. The plant must score from 80 to 89.5. This is a coveted award which is given only to plants of exceptional beauty and outstanding qualities. The next and highest award the American Orchid Society can give to an orchid, is the First Class Certificate of FCC/AOS. A score of 90 points or more is required. Very few orchids ever receive an FCC/AOS. In order to receive 90 points or higher, the orchid must be superior in so many qualities, such as brilliance of coloring, larger size flowers, and exceptionally fine shape with flowers well carried on a good strong stem.

There are other awards of which the amateur should know. One which is especially important to those who favor the species is the award known as the Certificate of Horticultural Merit. It is granted to a species orchid which is notable for its charm and beauty and which could be used for hybridizing or which has desirable qualities beyond being unusual, odd, or rare. The Certificate of Cultural Merit is an award given to plants shown by an exhibitor which have been grown to special size and beauty and show excellence of culture. Basically the award is transient in that, while a particular plant which has received this award will carry the CCM on all divisions, the award is granted to that plant at the moment of its specimen culture. The division carry-

Phalaenopsis Misty Moon is the recipient of several AOS awards.

ing the symbols of a cultural award does tell you that particular variety lends itself to specimen culture.

Of special value to those interested in finer orchids and in understanding the award system is the American Orchid Society's Awards Quarterly. This publication lists all AOS awards with illustrations. It is not only very educational and interesting but it is a wonderful "want list" to those who desire to build a collection of superior orchids of award quality.

While a system of awards is invaluable and indispensable, it must be used in conjunction with your basic appreciation of beauty. Most people who raise orchids appreciate beautiful flowers and do not need to run a plant through a series of measurements and tests to determine whether or not it is beautiful. Within us all, we have the basic ability to look at something and, within our own minds, determine whether or not we consider it beautiful. If we let ourselves be governed too much by rigidity of thinking and by what we are supposed to like, it can destroy our basic appreciation of beauty.

It has been my observation that the general public, those who come into an orchid nursery and look at the flowers, are often just as capable of spotting a fine orchid or one of award potential as the best trained judge. The average person will look at a flower and give what we could call a "gut response." Very often this is quite accurate. When something like this is then submitted for judging, it goes through a more scientific and expert appraisal. This confirms for the record books the superior qualities of the plant and that the plant is worthy of an award.

While an award system definitely has its place, the majority of orchids, while not of award caliber, are beautiful.

It is also important to know that many awarded orchids are fine parents, however, many famous orchid parents have never received awards. ❦

Orchid societies and their shows provide an opportunity for you to share information and have your plants judged.

WHY JOIN AN ORCHID SOCIETY?

JANET HOWE

In the United States, if you walk into an average florist shop or nursery and ask for orchid plants, you'll possibly be shown a tiny selection of cattleyas, ymbidiums, phalaenopsis, and/or paphioedilums at inflated prices, and receive ndifferent or incorrect instructions for culure.

If you hope to grow more than two or hree orchid plants on your windowsills, nder lights, or in your greenhouse, nembership in a local, regional, ational, or international orchid society s your "Open Sesame" to the wonderful orld of what has been estimated to be pproximately 17,000 species of these ntriguing plants (some still undiscovred). In addition to the species, there re many, many thousands of man-made ybrids with registered parentage and complex bloodlines dating back to 1852 when the first orchid hybrid was made in England.

I joined my first orchid society, the Greater New York Orchid Society (which meets every fourth Wednesday of the month at the Snuff Mill of the New York Botanical Garden in the Bronx) because I'd heard that members' own surplus plants were sold at reasonable prices, before every 8 p.m. program. Members gather at 7 p.m. to sell and trade plants and supplies, and dues per year (1985) are still $15 (individual) or $18 per family membership (barely enough to pay for the monthly newsletter plus the coffee and Danish served at meetings).

However, for this small annual fee, one is afforded the opportunity to meet fellow orchid lovers, both amateur and professional on a one-to-one basis.

The Greater New York Orchid Society

ANET HOWE *reviews orchid books and writes orchid "hats" for several orchid society magazines.*

monthly meetings, like other local societies in any metropolitan area, offer cultural information by advanced growers, slide programs given by qualified speakers on many aspects of orchid growing, collecting, conserving, hybridizing, or whatever you always wanted to know about orchids but didn't know whom to ask. Informal roundtable discussions on every facet of the hobby are another feature of monthly local society meetings.

Many societies hold an annual auction at which superb orchids (both donated and purchased) are offered to the highest bidders. They have a show table at every meeting and awards are given deserving plants . . . great for the ego if your plant is selected, a learning session even if it's not. Experienced growers extend their hands whenever novices encounter problems.

The American Orchid Society, with more than 400 local or regional affiliated societies, is headquartered at 6000 South Olive Ave., West Palm Beach, Florida 33405. The AOS is international in scope. Meetings are held twice a year in designated American cities.

Meetings, however, are not the main reason for joining the American Orchid Society. Its monthly publication, the *American Orchid Society Bulletin*, is. For $20 a year, members of AOS receive twelve issues of one of the biggest magazine bargains extant. It features color-illustrated articles by knowledgeable writers on every topic dear to an orchidophile's heart, notes on new orchid books, announcements of coming shows and special events, and regular departments such as Speaking Orchid-wise, the Question Box, and New Orchid Hybrids (reprinted from the English *Orchid Review*).

Interesting as these sections are, true hobbyists turn first to the ads and read the Bulletin from back to front, eager to learn what's new where.

Why join an orchid society? The answer is almost impossible to put into words because it's never exactly the same experience for any two individuals. Personally, although I was intimidated by al the talk of this mericlone and that backbulb for almost a year after I joined my first society, I'm now able to give lectures to horticultural societies and garden clubs, and as the detergent ad says "That's an improvement."

The American Orchid Society, a group with almost 26,000 individua members, publishes the color-illustrated *AOS Bulletin*, a monthly magazine containing articles ranging from basic cultural techniques to scientific survey of orchid genera. Other publications o the society include an Awards Quarterl reporting on all orchids receiving award at the eighteen official AOS judging centers. Membership in the AOS includes Bulletin subscription and a copy of th AOS orchid culture booklet. Dues (1985) are $20 per year in U.S. and $26 for fo eign memberships. The AOS works wit 416 affiliated societies located throughout the U.S.A. and forty foreig countries. Various AOS committees function internationally in the fields o education and research, conservation orchid history, and awards. The AOS is sponsor of the triennial World Orchi Conferences. Monthly AOS Judging take place at eighteen centers sprea throughout the continental U.S. an Hawaii. Schedules for the official judings are listed in the *Bulletin*. For a fre brochure covering membership benefi write to:

AMERICAN ORCHID SOCIETY
6000 SOUTH OLIVE AVENUE
WEST PALM BEACH, FL 33405

WORLD ORCHID CONFERENCES

Stanhopea wardii

Every three years the international orchid community stages a World Orchid Conference. Each conference is held in a different country but always in a nation where the active local orchid societies are filled with energetic members receptive to visitors from abroad. An elaborate orchid show is the highlight of every World Orchid Conference.

Visit a World Orchid Conference for an exciting introduction to orchid growing. Orchid experts from many countries present programs related to current research and all aspects of orchid growing. Commercial displays offer the latest hybrids and rare species grown from seed and by tissue culture. Various products useful in orchid culture are on sale.

Most conferences include a special show section devoted to art. Here orchid paintings, sculpture, ceramics, and similar representations of orchids by professional and amateur artists are exhibited, judged, and awarded. In the main show section orchid flowers, plants, and whole displays of live blooming orchids are evaluated by judging teams who award an array of cups, ribbons, plates, and plaques.

Visitors gather at the seventh World Orchid Conference in Medellin, Colombia.

Local society members offer home visits with hobby growers, the official conference travel agents arrange side-trips to places of interest, and commercial firms welcome conference registrants with special tours through their establishments.

Future World Orchid Conference locations include Tokyo, Japan (1987) and New Zealand (1990). Recent conferences have been held in Miami, Florida (1984), Durban, South Africa (1981) and Bangkok, Thailand (1979). The conferences offer you an excellent opportunity to learn more about orchids on an international level.

[C.M.F.]

SOURCES

SOURCES OF ORCHID PLANTS AND GROWING SUPPLIES

Several large commercial orchid ranges in the United States offer good assortments of popular genera and the supplies required to grow them. Other smaller orchid nurseries, although offering mail-order service, specialize in a limited number of genera or specific types of orchids such as cool growers or miniatures. Local garden supply stores offer some supplies used in growing orchids but the proper potting media for orchids are difficult to find in some regions. You may order potting media and mixtures from the large commercial nurseries listed here. Some local orchid societies accommodate members by pooling orders for growing supplies, thus saving postage. Botanical garden shops often carry small quantities of potting mix for orchids.

Listed here are a few of the larger orchid firms. For an extensive display of current orchid firm ads please consult a copy of the American Orchid Society *AOS Bulletin*. Firms listed below are experienced in mail-order shipping of orchids but requesting shipment to areas below freezing during the winter increases the risk that orchids will be damaged. For the most secure shipment to states with cold winters request delivery between April and November.

Arm-Roy (Armacost and Royston)
3376 Foothill Rd.
Carpinteria, CA 93013

Jones & Scully, Inc.
18955 S.W. 168th St.
Miami, FL 33187

Orchids by Hausermann, Inc.
2N134 Addison Rd.
Villa Park, IL 60181

Rod McLellan Co.
1450 El Camino Real
South San Francisco, CA 94080

Fred A. Stewart Co.
1212 E. Las Tunas Drive
San Gabriel, CA 91778

Zuma Canyon Orchids
5949 Bonsall Drive
Malibu, CA 90265

OVERSEAS SOURCES IN THE TROPIC

Many overseas orchid sources are located in tropical countries where orchids are native. The modern trend is for commercial firms to select the best clones of indigenous species, then grow more from seed and/or meristem culture. International regulations require that all orchids entering the United States be accompanied by official CITES documents, conforming to the USA's agreement to cooperate with laws to protect endangered species. Orchids sent to the U.S. without the required documentation (Certificate of Origin and CITES papers from the country of origin) will be confiscated by the U.S. Agricultural Inspectors at port of entry. The overseas orchid growers listed below are some of the established firms that are prepared to send all CITES required documentation with their export plant shipments. Note that to import orchids from overseas you will also need a permit from the U.S. Department of Agriculture, available free from the USDA (Permit Unit, USDA, APHIS, PPQ, Federal Bldg., Rm. 368, Hyattsville MD 20782).

Green Orchids (Mr. Shat Lun Cheng)
P.O. Box 7-587, Taipei, Taiwan
Meristems of outstanding cattleyas and phalaenopsis. $5.00 color catalog.

Kabukiran Orchids (Mr. & Mrs. Javier)
P.O. Box 744
Quezon City, Philippines
Philippine species, $1.00 catalog.

Ooi Leng Sun Orchids
(Mr. Michael Ooi)
873 Sungei Dua
Butterworth, Wellesley, Malayasia
Malayasian species and their hybrids.
Free catalog.

Simanis Orchids
(Mr. Atmo Kolopaking)
P.O. Box 8
Lawang, East Java, Indonesia
Indonesian species and primary hybrid
Free list.

T. Orchids
(Mr. Thonglor)
P.O. Box 21-19
Bangkok 21, Thailand
Hybrid dendrobiums and vandaceo
types plus Thai species. $5.00 color catalo

FURTHER READING

CULTURE

All About Orchids by Charles Marden Fitch. Doubleday and Co., New York. Complete guide to modern cultural techniques, hybrids, international sources of plants.

Handbook on Orchid Culture by the American Orchid Society. A booklet covering basics of orchid culture. Available from AOS.

Miniature Orchids by Rebecca Northern. Van Nostrand Reinhold Co., New York. Small-growing orchids for the home.

Orchid Culture Under Lights by Richard Peterson. Indoor Light Gardening Society of America. An illustrated 19-page paper-back booklet available from the Indoor Gardening Society, 128 W. 58th St., New York, NY 10019.

The Paphiopedilum Grower's Manual by Lance A. Birk. A book written for the orchid fancier who wants to learn everything there is to know about the Lady Slipper orchids. Available from the author at 1721 Las Canoas Rd., Santa Ba bara, CA 93105.

REFERENCE

Encyclopaedia of Cultivated Orchids by Alex Hawkes. Faber and Faber Ltd., Londo Includes some culture notes.

Orchid Biology, Reviews and Perspectives edit by Joseph Arditti. Cornell University Pre Ithaca, NY. Advanced scientific papers.

The Manual of Cultivated Orchid Species Bechtel, Cribb, and Launet. MIT Press, Ca bridge, MA. Many color photos.

The Orchids, Scientific Studies edited by Car Withner. John Wiley & Sons, New Yo Research papers collected, illustrated.

Handbook on Orchid Pests and Diseases. Use paperback from The American Orchid Soci Most recent edition is available directly from e AOS office. Revised in 1985.

GLOSSARY OF ORCHID TERMS

The glossary presented here is in no sense comprehensive. It contains essentially those terms which the reader of the foregoing articles night find difficult or confusing. Botanical erms should not be frightening; they are xact and once a grower becomes accusomed to them, they are invaluable in liscussions of one's orchids.

Award initials. The FCC/AOS, AM/AOS, etc., which may follow an orchid's name. See "Benefits of the AOS Awards System" (page 82) for explanation.

Back bulb. One of the older *pseudobulbs* on an orchid plant, suitable for use in propagation.

"Botanical." Orchid-growers' slang for all small or non-showy kinds of orchids, in contrast to the commercial corsage types of orchids. For the most part, these are grown and hybridized by hobbyists. (A better term is needed.)

Callus. An area at the base of the lip of the orchid flower that apparently is attractive to insects. Among orchid specialists it provides a diagnostic character for differentiating species.

Clone. All the plants derived by successive vegetative propagation, beginning with one original plant. In writing, the clonal name is set off in single quotation marks.

Column. The unique reproductive structure found only in the orchid family. The *stamens* are generally reduced to one or two (occasionally three are present) and are fused with the *style* and *stigma* of the *pistil*.

Community pot. Often referred to as a "compot." The single pot or other container in which orchid seedlings are planted in groups of 15 to 20 after removal from the sterile culture bottle in which they were first sown.

Corm. A solid, bulblike, fleshy base of a stem, common to many terrestrial orchid species.

Crock. Another word for potsherds—pieces of broken flower pots which are placed in the bottom of a pot for drainage.

Cultivar. A race of plants, originated and maintained in cultivation for unusual or desirable qualities and given a special name. Distinct from a species.

Deciduous. Literally, *falling off*; used of plants which drop their leaves seasonally.

Epiphyte. Literally, *on a plant*; one plant which grows upon another, but *not as a parasite*. An epiphyte merely perches on the trunk or branches of its dwelling place—usually a tree.

Grex. All the sibling plants produced by hybridizing two species, a species and a hybrid, or two different hybrids.

Hapuu. Hawaiian tree fern (*Cibotium glaucum* or *C. chamissoi*). The aerial roots, which surround the trunk in a thick, matted layer, are used as a potting medium for orchids.

Keiki. Hawaiian word meaning a child or little one, used as a name for the offshoots or plantlets that develop from the main stem or on old flower spikes of certain orchid species. After their roots have developed they may be separated from the mother plant and grown as new individuals.

Labellum. The lip of an orchid flower, formed by one of the three petals.

Lead. A new growth arising on a sympodial orchid.

Mericlone. A plant produced by "meristemming."

Meristem. As a noun, *meristem* refers to embryonic tissue, the cells of which are capable of active division. As a verb, it is orchid-growers' slang for the method of propagation by which the apical cells are removed from an orchid shoot tip and grown on, by continued division, as individual plants. A plant produced by this method is called a *mericlone.*

Monopodial. One of the two types of growth habits in plants. (Compare *sympodial.*) *Mono,* meaning *one,* gives a clue to the meaning of the word. Monopodial orchids have only one stem, which grows continuously from the apex, on and on. As the stem elongates and produces leaves and flowers, roots come not only from the base, but usually also from the stem itself.

Osmunda. Roots of ferns of the genus *Osmunda,* used as a potting medium.

Ovary. The part of the *pistil* that bears the bodies (ovules) which can become seeds when fertilized. In an orchid flower the ovary is situated *beneath* the sepals and petals.

Pistil. The female reproductive structure of flower, consisting of *stigma, style* and *ovary.* In an orchid flower, stigma, and style are fused with the *stamens* into a *column.*

Pollen. The male reproductive cells in a flower; in an orchid flower, usually borne on the *column* in a coherent mass called a *pollinium* (plural: *pollinia*).

Protocorm. The stage of growth of an orchid seedling before any leaves or roots have become differentiated. The minute embryo in the seed will have developed only into a little ball of cells.

Pseudobulb. A solid, bulbous enlargement of the lower part of the secondary stems, common among *epiphytic* orchids.

Rhizome. In general botanical parlance, a horizontal primary stem, either underground or at the soil surface. In *epiphytic orchids,* which grow on tree branches and other non-granular surfaces, there is no surrounding soil. In *sympodial* orchids, the rhizome connects successive growths, the distance between which varies in different species from a fraction of an inch to two feet.

Selfing. Pollinating a flower with its own pollen. While self-pollinating is usually avoided in the orchid family, it is sometimes desirable to increase the number of plants in a given strain or to maintain a certain group of genetic traits.

Semi-alba. A descriptive word of commercial coinage used to designate a cattleya hybrid with white sepals, two white petals and a colored lip.

Stamen. Male reproductive organ in a flower, bearing at its tip the fertilizing cells called *pollen.* In an orchid flower, incorporated into the *column.*

Stigmatic surface. That part of the *column* of an orchid flower which receives the pollen. It corresponds to the *stigma* of flowers in other families.

Style. The stalk of the *pistil* which connects the *stigma,* at the tip, with the *ovary,* at the base. In an orchid flower, the *style* is incorporated into the *column.*

Sympodial. One of the two types of growth habits in plants. (Compare *monopodial.*) In sympodial growth, the apex of a stem does not continue growth; instead growth is resumed by a bud below the apex (in an orchid, generally on the rhizome) which repeats the process. As a sympodial orchid puts out new growth periodically at its base, it "walks" along year after year, growth after growth.

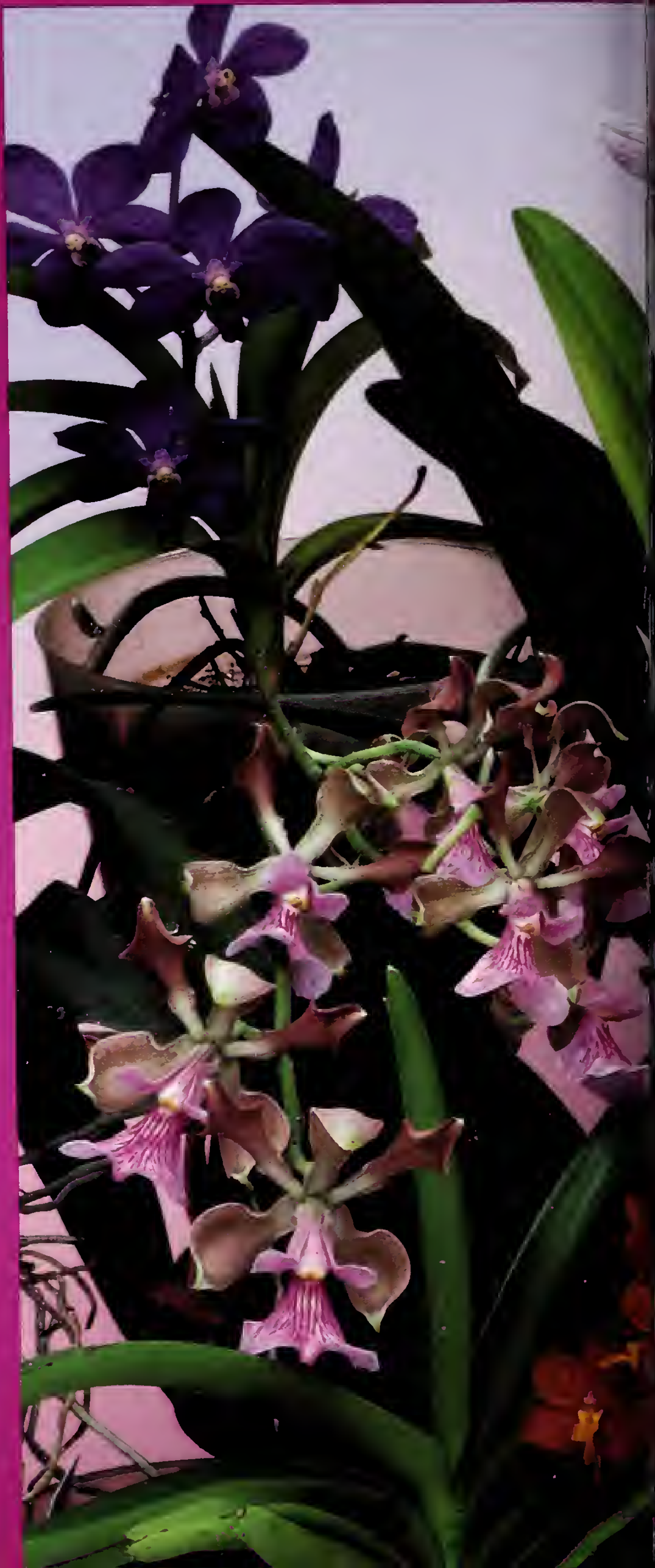
Tepals. Sepals and petals of a flower when they are similar in form and color.

Terete leaves. Fleshy, cylindrical leaves which taper to a point. They can vary from the size of slender knitting needles to that of big cigars.

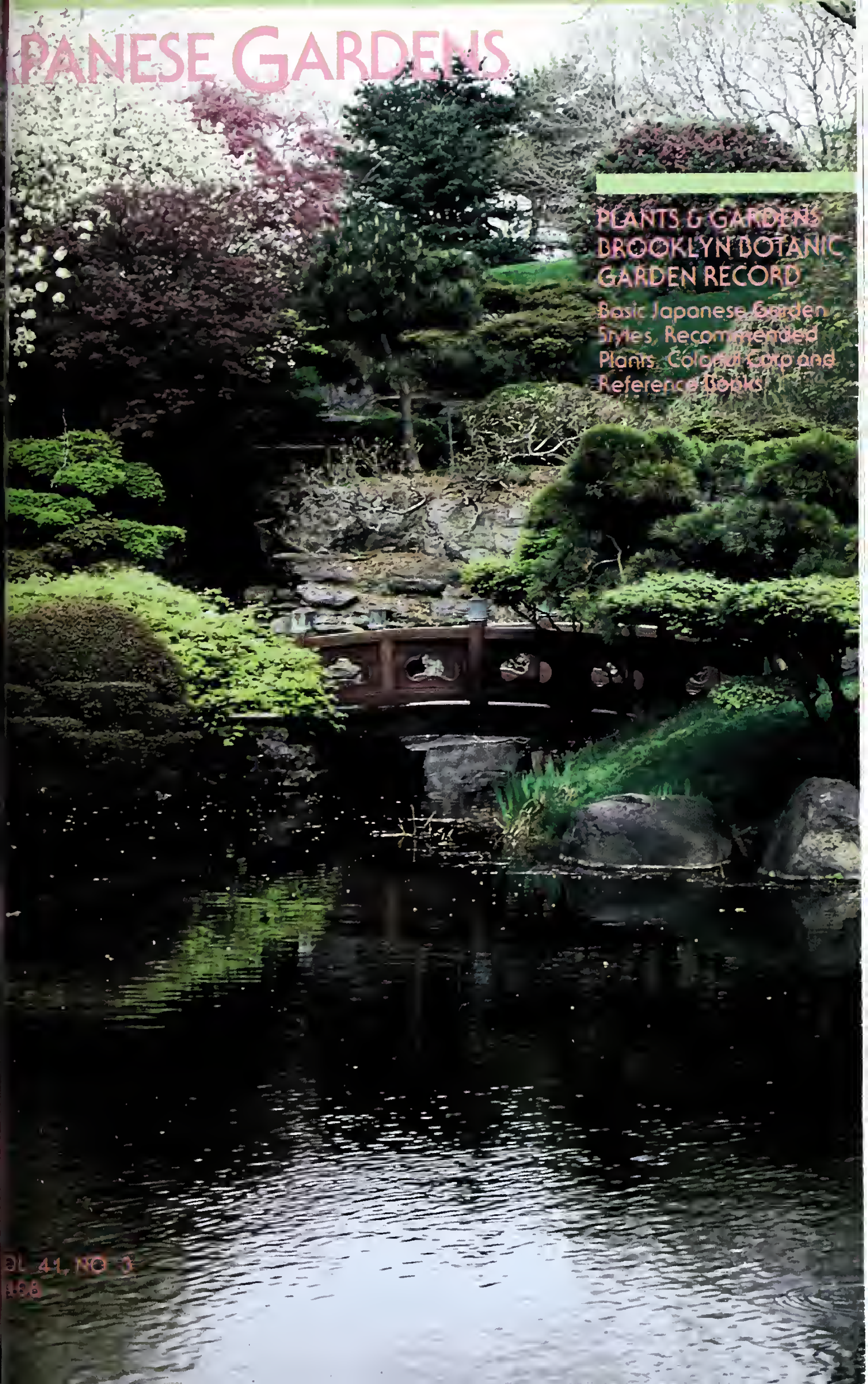
Velamen. The white, thick, spongy, absorbing and anchoring layer of cells that covers all but the growing tip of the aerial roots of orchids.

Xerophytic. Adapted to a dry environment, succulent, wax-covered leaves and fleshy stems being the usual modifications. Most epiphytic orchids show one or more such adaptations, as do cacti and other succulent plants. ❦

Practical handbooks to share the Brooklyn Botanic Garden's 76 years of excellence in horticulture, education and community service.



PANESE GARDENS



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Basic Japanese Garden Styles, Recommended Plants, Cultural Care and Reference Books

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Brooklyn Botanic Garden

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PLANTS & GARDENS

BROOKLYN BOTANIC GARDEN RECORD

JAPANESE GARDENS

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Cover photograph: Brooklyn Botanic Garden's Hill-and-Pond Garden in Autumn by Everett Ortner

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JAPANESE GARDENS

LETTER FROM THE BROOKLYN BOTANIC GARDEN

Japanese views on gardening have been of major interest here at the Brooklyn Botanic Garden, and evidently to the readers of *PLANT & GARDENS* as well, for our handbooks on bonsai continue to head our list of best sellers. The previous handbook entitled "Japanese Gardens and Miniature Landscapes" completed in 1961 went through numerous printings before the present entirely new edition was completed.

In the pages that follow the reader will find many references to tranquility, peace, and quiet beauty. Perhaps it is the search for these qualities in our pressure ridden, fast-paced lives that generates the interest in creating Japanese gardens here in the States.

BBG's own Japanese-Hill-and-Pond Garden was designed and constructed by Takeo Shiota in 1914–15 and remains today a focal point. Throughout the entire year this garden provides a panorama of peace and beauty. Flowers are used with restraint and the evergreen trees and shrubs, in association with rocks and water, present an ever-changing vista as paths are traveled. To the Japanese each garden is designed to mirror nature—it is a landscape in condensed form.

Claire Sawyers, who has lived and worked in Japan, has gathered together a particularly talented group of contributors for this issue. All bring expertise from their fields of concentration to enlighten the reader on every aspect of understanding the art of the Japanese garden. The contributors have related their personal experiences, personal viewpoints and opinions, and first-hand knowledge to provide new insights into this garden phenomenon. Sometimes it is easier to see through the eyes of someone else than it is to see with our own eyes, and these authors indeed have keen vision.

Whether you wish to create a Japanese garden or just gain better understanding of their meaning, we wish you good reading and good gardening.

Barbara B. Pesch

ROCKS, ISLANDS, MOUNTAINS, AND THE JAPANESE GARDEN

T. Kaori Kitao

A JAPANESE GARDEN may be created without flowers, grass, ponds, streams, mounds, paths, and even trees and shrubs, but a Japanese garden cannot exist without rocks. They appear in every conceivable size and shape and arrangement. There are boulders, fist-size stones, smooth, or rough, some covered with moss, and others tall and soaring while still others flat and sprawling. They appear in rows or in clusters, strung out to form a water's edge and sometimes strewn in profusion to simulate a rocky landscape; or half buried in grass, they may escape our glance; or a single lonely stone, seemingly abandoned, may intrude into a path to draw attention. Rocks can be composed as a stone lantern, and carved to form water basins.

In Japan, rocks are not just rocks; they are privileged objects, objects that demand very special attention. When the Japanese discuss rocks, they discuss them with reverence, considering each rock individually, identifying features and exercising the critical discrimination of a collector of works of art. Shape, aspect, colors, and grains of each rock, and even of its force and energy and the sense of presence are considered. Starting with the 11th-century manual, *Sakuteiki*, the art of choosing, laying and arranging rocks has been closely studied and prescribed.

Rocks, Islands, Mountains

The fascination the Japanese hold for rocks is a deep-rooted cultural phenomenon, and its sources can be located in Japan's topography, mythology, and early literary iconography.

Topographically, Japan is a volcanic archipelago, two-thirds of which consists of mountains. Its coastline is jagged, rocky, and strewn with

A traditional stone water basin placed beside a pond. A dipper invites one to rinse the hands in symbolic cleansing. Plants and rocks complete the scene.

Brooklyn Botanic Garden

innumerable islands. Mountains, islands, rocks, therefore, form a continuum as visual forms. Islands are, after all, rocky mountains in water.

Rocky coasts, on the other hand, are not unique to Japan. But the spiritual outlook of the Japanese toward the rocks that surround them is something special, and Japanese mythology is informative on this point.

Rocks as Sacred Dwellings

Some of the oldest archeological remains in Japan, from the Middle Jomon Period (ca. 2000 BC) are arrangements of radially placed natural stones with an upright stone at their centers – unmistakably phallic in form and meaning. The belief was most probably that the god of procreation dwelt in the stone. In the Shinto worship, with its strong strain of animism, gods or spirits dwell in everything everywhere. In its most primitive form, however, the indigenous Japanese religion entertained the notion of *mononoke* – literally, "the spirit of things." Both matter and space – the forces that pervade the universe; and rocks were seen as the privileged loci of these forces, the dwelling places of the deities. To this day there are certain rocks, individually or in a group, in the precincts of some older shrines, which are so designated with hallowed ropes and paper; they are called *iwakura* ("rock-seat"); or, if the whole area around is marked, *iwasaka* ("rock zone").

To the Japanese, then, rocks are ubiquitous, and yet they also invoke a sense of reverence and even religious awe as though they hold the mystery of life and nature. The ancient Japanese believed, in fact, that rocks grew. This idea is repeated in the poem which is sung today as the Japanese anthem: – "may the nation live and thrive thousands of years till the pebbles have grown to be boulders covered with moss." To the Japanese rocks have always been simple and humble and yet divine; at the same time awesome and familiar.

Literary Sources

Skeptics may still argue, however, that it is not uncommon in primitive religions that trees and rocks and mountains are imbued with mystery and viewed with awe.

The unification of Japan by the Yamato clan took place in the 5th century, and thence comes the earliest evidence of Japanese literature. The poets of the day praised the three mountains of the Yamato basin, Kagu and Miminashi, both male, flanking the female Unebi, none very tall but often seen floating above the mist which collects in the area. The Inland Sea with its numerous islands and rocky shores was equally important in the cultural life of early Japan because of its role as a chief channel of communication. Its image was surely well etched in the memories of many travelers and poets.

Garden as Island

The mountain is sacred in many other cultures as well. But in Japan, topography and mythology worked in consort to reinforce the literary iconography, and it is the merging of the mountain with the rock and the island that is unique and of special significance to the history of the Japanese garden.

In the writings of the 7th and 8th centuries (Nara Period), the garden was called *shima* which is the same word as "island." We know, too, that the earliest Japanese garden featured a mound and a pond and an islet connected to the shore by a bridge; Emperor Shomu (724–29) is said to have had three such gardens in Nara. Thenceforth, the garden, called *shima* or not, could not be conceived without rocks and mounds signifying not only islands but also mountains.

The Mountain of Immortals

To complicate the matter further, however, the influx of Chinese culture in Japan during the Nara Period gave the iconography of the island overlays of Taoist and Buddhist sources which concerned mountains. They are the *horaisan* and the *shumisen*.

Horaisan, or Mt. Horai, as understood in Japan, is a Taoist island-mountain of eternal youth, a sort of Elysium or Paradise. The legend goes that in 221 B.C. the first emperor of China, Ch'in Shih Huang-ti, dispatched Hsu Fu to Mt. Horai in pursuit of the elixir of life to be found on this island of immortals. But, as it happened, he landed in Japan and never returned home. He settled there with the youths and maidens who accompanied him and eventually died there.

Horaisan is, for the Japanese, the legendary Japan and yet a mythical place as well, believed to be inhabited by cranes and tortoises, both creatures of exceptional longevity, and covered with pines, peaches and plums, also known to live and grow for many centuries. These are all familiar themes that continue to recur in Japanese gardens as well as in literature, theater, and

Brooklyn Botanic Garden

Japan's coastline is jagged, rocky, and strewn with innumerable islands. Here a picturesque pine complements the shore.

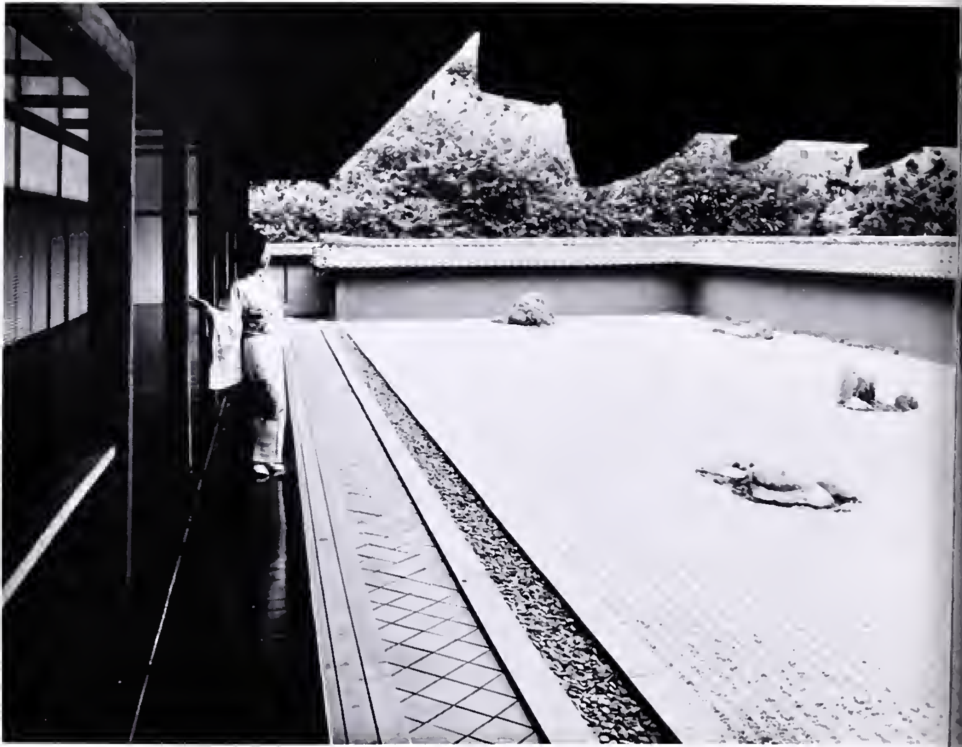
various festive and religious iconography.

Shumisen, or Mt. Sumeru, is the center of the world in Buddhist cosmology. It is a sacred mountain somewhat analogous to Olympus, the summit of which is the dwelling of Taishakuten, one of the 12 guardian deities. As early as 657 AD, according to the ancient chronicle *Nihongi*, a model of the mountain was constructed at the Asuka Temple near Nara. It was this stone "statue", known as yamagata ("mountain-form"), which shumisen referred to in particular in Japan, especially in garden design. The stone was actually excavated in 1902.

The *shumisen* and the *horaisan* have thus enriched the image of the rock as an island-mountain; and through the history of the Japanese garden, they remained fused in the general iconography of the rock.

Multiple Meaning

It always baffles Japanese to be asked what the rocks in Japan's gardens mean. For, on the one hand, there is no simple answer to the question; and, on the other, it seems so self-evident as to require no explanation. Used in the garden, a rock may be a *shumisen*, a *horaisan*, a particular island scene, or simply any mountain; or it may be just a rock, nothing more and nothing less. But whatever the specific reference, it cannot be understood free of the multiple images from the topographical, mythological, and literary history that constitute its iconography: the rock as island, as mountain, as holy place, as garden. Whatever its specific reference, the rock is something that immediately and inescapably appeals to the Japanese. And, for the most part, a Japanese does not have to be well read in classics or versed in mythology and archeology to sense that, for it is an iconography that survives—in the inevitable cultural circularity—in Japan's gardens, which serve as literature and mythology in living form. In this way, rocks form an integral part of Japan's collective memory—their multiple meaning implicit.



Replica of the Ryoanji Stone Garden as it was at Brooklyn Botanic Garden. This garden will be reconstructed in the future. Such gardens have a special appeal to contemporary taste because of the simplicity of design.

Estelle Gerard

BASIC JAPANESE GARDEN STYLES

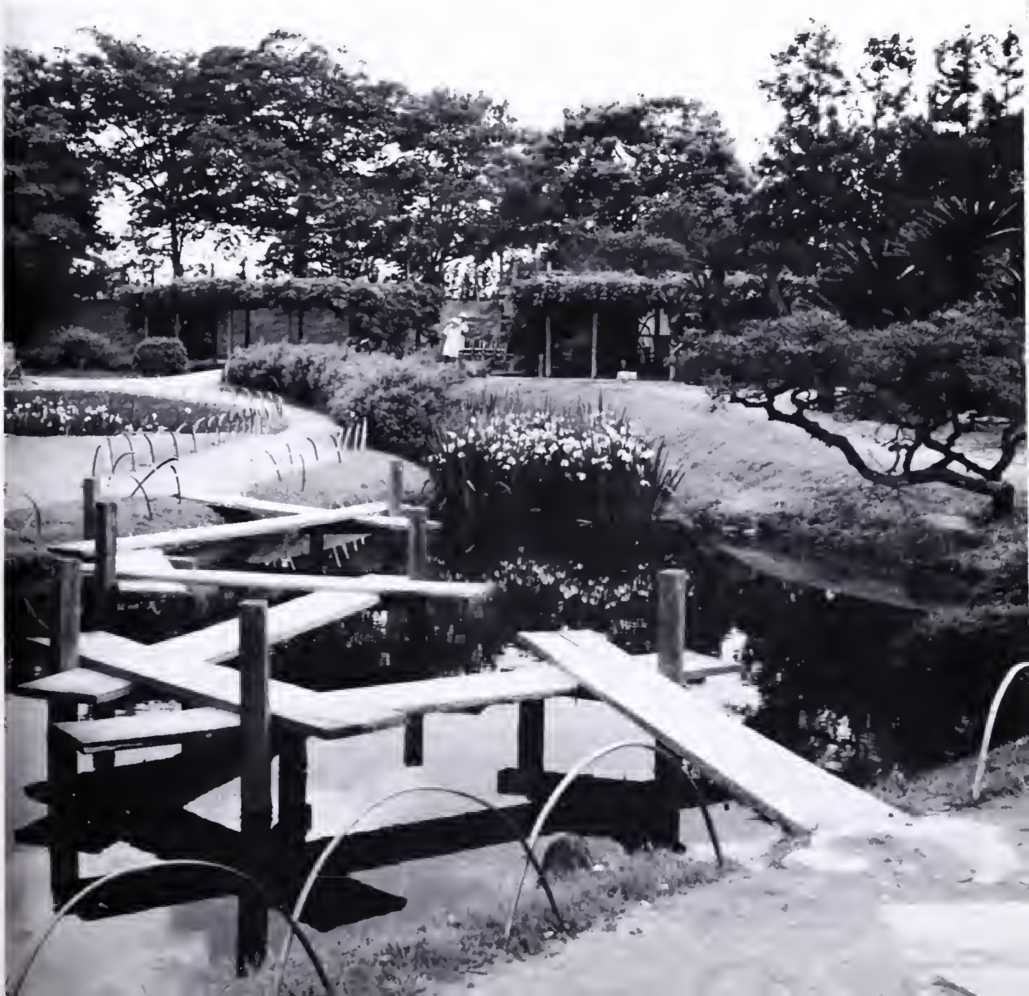
Stephen A. Morrell

WHEN INTERPRETING or viewing a Japanese garden, first consider that several distinct styles exist. As with most garden styles, however, the influence of one style can be seen on another. In the west this is often planned and different styles of Japanese gardens are blended together in attempts to capture everything.

The Japanese describe many garden styles, but, there are five basic styles. First, one of the oldest styles – the "Hill and Pond Garden," constitutes the main body of Japanese garden styles of which there are many variations. Here nature is represented by artificially constructed hills and pond, suggesting mountains and ocean. Shrubs are trimmed to complement the undulating contours of mountains and clouds, as well as to maintain scale. Trees are kept pruned and trained to look old and windswept and a major portion of the garden can be seen from any one point. It is understandable why this style is prominent since it resembles the natural landscape of Japan.

Second, the *karesansui* or "Dry Landscape" garden, traditionally associated with Zen temples, is usually a small space created as an aid to meditation where nature is reduced and sug-

An "eight plank" bridge is often used in Japanese gardens. The zig-zag arrangement necessitates turning as the bridge is crossed giving various views of the garden.



Jeremiah Foley

Brooklyn Botanic Garden's own Hill-and-Pond Garden illustrates one of the oldest Japanese garden styles. Hills and a pond were created to suggest mountains and ocean.

gested using only stones, raked gravel,* and a minimum of plants. The technique of *shakkei* or "borrowed scenery" is often used by incorporating a distant vista as a background of the design, thereby perceptually enlarging the size of the garden. (The borrowed scenery technique is also used in other garden styles.) In Japan, dry gardens are viewed from a veranda and not entered as this would ruin the delicate relationship and scale of the composition. Variations of this style are often found incorporated into other styles in the west.

Third, the teagarden or *Roji*, literally meaning "Dewy Path" is simply a stepping stone path modeled after a mountain trail leading to, and providing a setting for, the teahouse. The path features a stone lantern which is lit for evening tea gatherings and a stone water basin where guests rinse their mouths and hands in an act of purifying body and mind before entering the teahouse. The use of stepping stones, stone lanterns, and water basins in gardens originated with the teagarden and these are common components in later garden styles. Plants in a teagarden are mostly evergreens creating a subdued atmosphere conducive to appreciating the tea ceremony. The teagarden and Dry Landscape garden, or variations of them, have become increasingly popular because their small size and simplicity make them practical.

The fourth style, the "Stroll" garden, takes advantage of tea garden techniques by incorporating stepping stones, stone lanterns, and usually a tea house or pavilion. Traditionally they were created by the nobility and designed on a large scale. Movement is around a pond and islands, employing the concepts of "Hide and Reveal" and "Movement Along the Diagonal." Rather than follow a straight axis, the path leads one left and right to reveal vistas gradually as one moves through the garden. Contrasting with the other garden styles, the entire Stroll garden cannot be viewed from any one point and requires active participation to experience it fully.

The fifth style, which is now very popular in Japan due to space limitations, is the "Courtyard" Garden. Here, the strong influence of the teagarden and Dry Landscape garden can be seen. This style is not yet common in the west.

A Japanese garden strives to be true to the essence of nature, a beauty that is quiet and refined. It has a static quality which is maintained by the predominance of stone and evergreen plants, and yet is constantly changing. Through the passing of seasons, change is expressed, and over time quality and depths are reflected by the effects of weathering. The spirit of a Japanese garden may not be easy to comprehend fully by viewing its physical elements only. The design encourages one to go beyond the surface and complete the picture in one's own mind. ❧

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*Frequently the word "sand" is used referring to *karesanui* gardens, but the gravel is more like a turkey grit than sand.

CLASSICAL PLANTS IN JAPANESE HORTICULTURE

Barry Yinger

SINCE THE OPENING of Japan to the west in the last century, countless books and articles have been published about the aesthetics and practice of Japanese horticulture. Most describe and illustrate the Japanese gardens, especially those of the nobility or the great shrines and temples. Some of these works successfully illustrate and interpret the development of the gardens of the privileged, but they scarcely touch the heart of Japanese horticulture: plants. The Japanese people grow a staggering variety of ornamental plants, perhaps more than any other nation, and have at the same time conceived some of the world's most beautiful and emotionally evocative gardens by using a very limited variety of plants. Some very fine gardens use no plants at all. What do they do with all those plants? The answers to that question lead to the heart of Japanese horticulture.

The famous gardens of Japan have not been an immediate part of the ordinary Japanese citizen's horticultural experience. Until recently most important gardens were open only to the elite, and even now access to many is greatly restricted. In any case, very few Japanese families, past or present, have more than a tiny scrap of garden space; many have none at all. Instead they have used the odd spaces at curbside and balconies and fire escapes. There is no limit to the Japanese ability to maintain an exciting array of plants in cramped and difficult surroundings. I have seen tubs of Japanese iris (*Iris ensata* var. *ensata*) on grimy curbs in industrial neighborhoods, blooming pots of the orchid *Cypripedium macranthum*, and the shrub *Menziesia ciliicalyx* var. *purpurea* at the base of vending machines on a busy street; more than 50 selections of Japanese maple (*Acer palmatum* and *A. japonicum*) in rows of pots on the roof of a store; and nearly 100 different selections of the epiphytic orchid *Dendrobium moniliforme* in tiny pots in layered wire racks on the small balcony of an apartment house.

Koten engei Defined

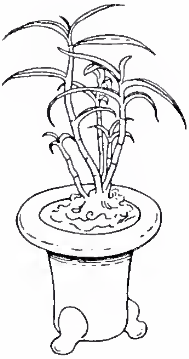
Much of this pot culture of ornamental plants is simply horticultural exuberance, but some falls into the category of *koten engei*. The term *koten engei* is difficult to translate precisely, but "cultivation of classical plants" comes close. It is the cultivation of selections of a limited number of plant species in pots according to certain rules and conventions.

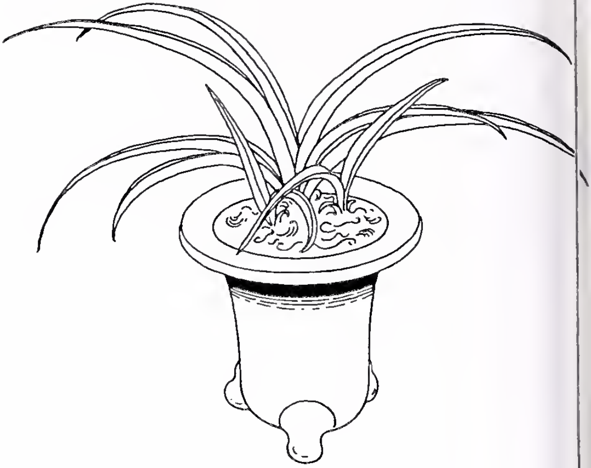
Koten engei is one of many branches of Japanese aesthetics in which a foreign model has been accepted, elaborated and gradually transformed into something distinctly Japanese. In this case, as in many others, the model was Chinese. Throughout Chinese history, selections of plants with showy flowers were grown in decorative pots to be used as temporary displays indoors and out. These plants, such as the peony (*Paeonia suffruticosa*) and chrysanthemum, were selected for color and form of their flowers. This concept was imported by the Japanese in the Heian Period (794–1192 AD) when Chinese influence shaped the aesthetics of Heian court society. Chinese-style pot culture was gradually transformed into the practice of growing myriad selections of certain species of native Japanese plants with subtle variations in leaf shape and pattern. The history of this transformation offers important insights into Japanese attitudes about ornamental plants.

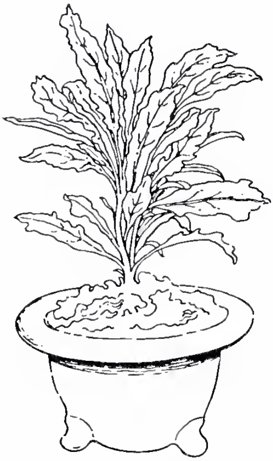
The History of Koten engei

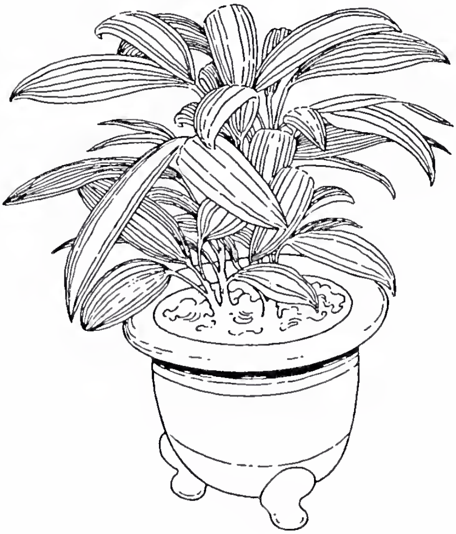
In the early years of the Heian Period the Japanese approach to aesthetics could be summarized by the concept of *miyabi*, best defined as "refinement and sophistication" from the point of view of a Japanese court society eager to isolate itself from the ignorant masses. The sumptuous elegance of court society in the Chinese style was a refuge not only from the common people, but also from the simple, rustic style of life that was later glorified by Japanese poets and artists. But the peace and stability of Heian times deteriorated into warfare and chaos as Japan endured nearly uninterrupted civil war from 1100 to 1800 AD.

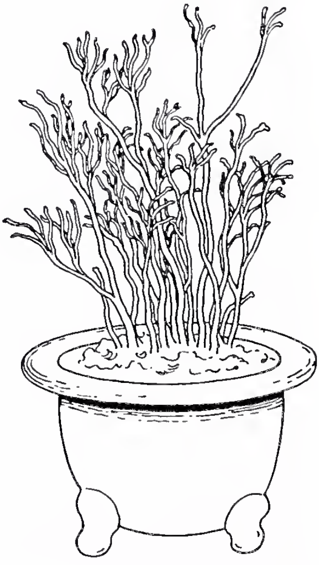
One reaction to the horror of war and social disorder was a new approach to aesthetics, sometimes summarized by the term *yūgen* which marked a retreat from glitter and ostentation.



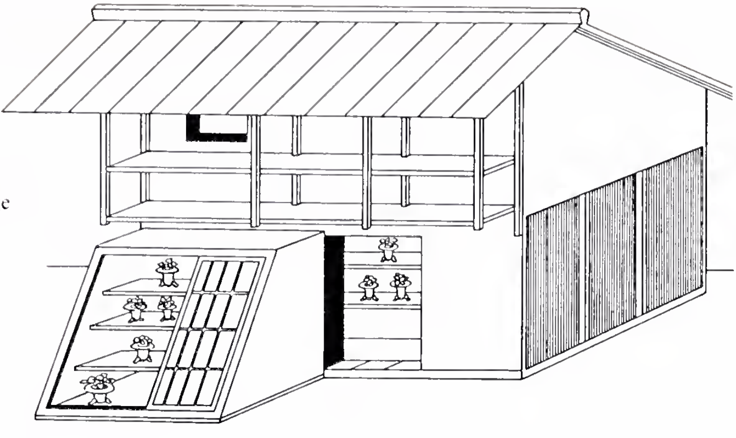








Above left: *Dendrobium moniliforme*
Above right: *Rohdea japonica*
Middle: *Ardisia japonica*
Below left: *Raphis excelsa*
Below right: *Psilotum nudum*



A structure for the display and winter storage of koten engei plants. The wide roof on the display section protects the plants from the afternoon sun.

Drawing is based on a design in the classic *Sō Moku Ki Hin Kagami*.

Yūgen emphasized the profound and mysterious, along with the value of simple forms stripped of distracting ornamentation. The term *sabi* also appeared, describing the pleasure which can be found in weathered or faded things.

This different approach came to be expressed in garden art and horticulture, and set the stage for the appreciation of the kinds of modest plants that came to be embraced by *koten engei*. The critical development that spurred this changed attitude toward beauty in plants was the development of the tea ceremony and its structure and gardens.

The tea ceremony developed as a peaceful refuge for men overwhelmed by the violence of their lives and times, leading them to a keen appreciation of a simple, rustic retreat within turbulent cities. The tea garden developed as a device to establish a mood of contemplation in the guests who passed through it to the tea house. Showy flowers were banished, replaced by humble herbs and shrubs which had previously been grown for medicinal and religious reasons near the dwellings of commoners and in the precincts of *Shintō* shrines. The sophisticated urban dweller now rejected the glittering complexity of the Heian court in favor of rustic materials and a simple style of floral decoration. Most of the species of plants which came to be part of *koten engei* were grown, or were suitable (in their original form) to be grown in the tea garden.

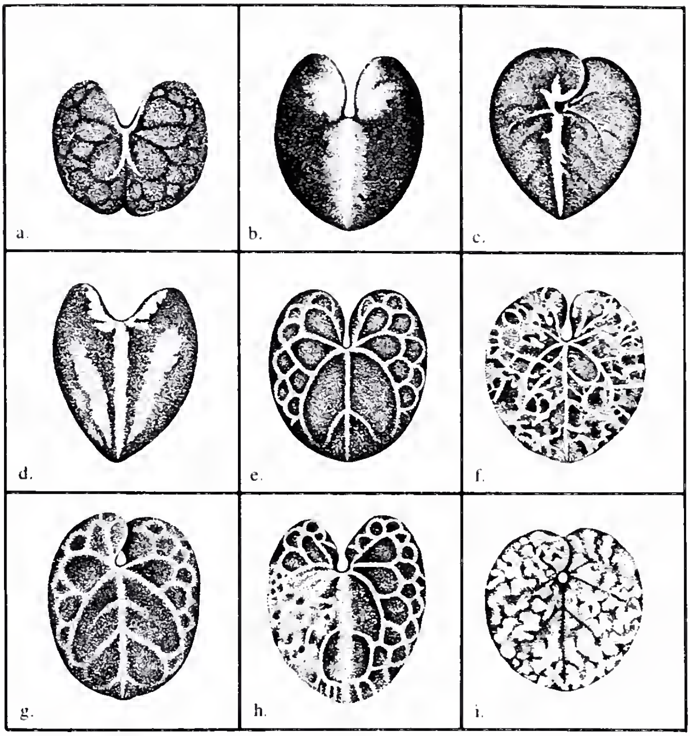
In 1603, Japan was united under the first Tokugawa *shōgun*, Ieyasu, who ruled from the new capitol at Edo (Tokyo). He and subsequent Tokugawa *shōguns* stimulated the development of the cult of *koten engei*. Ieyasu himself was an avid collector of plants at his home at Suruga. One of those plants was *Asarum* (wild ginger), which was also depicted in the family crest of the Tokugawa family.

Ieyasu's successor, Hidetada, also an avid plant collector, ordered officials throughout Japan to bring him unusual plants. The custom of presenting plant mutations to the *shōgun* quickly spread throughout the ranks of *samurai* and powerful citizens. We can be sure that *Asarum* and other *koten engei* subjects were among the plants presented.

The third *shōgun*, Iemitsu (1623 to 1651) was an even more avid plantsman than his predecessors. A book of 100 camellia cultivars, *Hyakuchinshū*, was published during his rule. Most important was his establishment of the system of alternate residence, under which all the landed nobility throughout Japan were required to spend part of each year in residence in Edo (Tokyo). Iemitsu encouraged these vassal *daimyo* to bring interesting plant mutations to Edo and assemble to discuss them.

The system of alternate residence stimulated the rise of a class of educated, moneyed commoners on the fringes of this unprecedented concentration of idle *daimyo* and their many retainers. The development of the "floating world" (*ukiyo*) to provide for their entertainment and comfort stimulated the democratization of art and entertainment. *Kabuki* theater, *haiku* poetry and woodblock printing (*ukiyo-e*) owe the strength of their popularity to the vigor and interest of the rising middle class.

Two related developments in ornamental horticulture are characteristic of this period in Japanese history: the evolution of the courtyard garden (*tsuboniwa*) and the rise of a mania for collecting mutations and variations of ornamental plants. Urban commoners, lacking the spa-



Some leaf characteristics (*gei*) used in classification of *Asarum* selections.

a. *biri o otsu*:	leaf tip strongly reflexed
uchidashi:	deeply sunken veins
b. *tamafu*:	large central variegated area (jewel variegation)
c. *tani* and *cho*:	central stripe and markings at base (valley and butterfly)
d. *sagari fuji*:	diagonal stripes of variegation on both sides of the leaf (hanging wisteria)
e. *kikko*:	large network of variegation following veins (tortoise shell)
f. *nagarefu*:	irregular indistinct variegation
g. *eriawase*:	overlapping basal lobes
h. *zu*:	asymmetrical yellow or white irregular variegation (map)
i. *gomafu*:	small regular spots of variegation (sesame variegation)

cious estates of the nobility, distilled the tea garden into the *tsuboniwa* to make use of small enclosed spaces among their houses. They retained the most emotional symbols of the tea garden: the stone lantern to light the way, the stepping stones to provide an unsoiled path, and the water basin to clean hands and mouth. This simple garden might be almost bare of plants, or include at most a few subdued trees, shrubs or herbs.

This movement to sparse, emotionally-charged gardens directly contradicted the simultaneous development of interest in the often bizarre mutations of a wide variety of plants. Because such plants had no place in the garden, and because collectors wished to grow many different kinds of plants in a very limited space, their mutations were normally grown and displayed in small pots. Weak or slow-growing selections were more suitable for long-term pot culture than vigorous relatives.

The Conventions of *Koten engei*

It is hard to say when unrestrained collecting of plant mutations came to be so ruled by convention that *koten engei* could be recognized as a distinct horticultural movement. We, like the Japanese who tried to define the movement in the last century, can only consider it in hindsight. Those who collected mutations in the past three centuries probably did not realize the rules they composed for selection and cultivation of mutations would become the conventions of a persistent horticultural movement. As there is no chronicle of the ideas and emotions of those who developed *koten engei*, we must look to the characteristics of the *koten engei* plant groups that have persisted to the present to understand it.

The following species are the original forms which have spawned the groups of selections most commonly grown as *koten engei* today:

Ardisia japonica (yabukōji)
Ardisia crenata (manryō)
Asarum spp. *(saishin)*
Cymbidium goeringii (shunran)
Dendrobium moniliforme (chōsei ran)
Nandina domestica (nanten)
Neofinetia falcata (fūki ran)
Psilotum nudum (matsuba-ran)
Raphis excelsa (kannon chiku)
Rohdea japonica (omoto)
Selaginella tamariscina (iwa hiba)

These species have several features in common:

1. All are Japanese natives which in their original forms are not showy.
2. The cultivated variants of the species are selections (aberrant forms) rather than hybrids. Except in some selections of *Cymbidium* and *Neofinetia* (orchids), selection is for characteristics other than flower form and color, and even those selected for floral characteristics are not very showy. Most selections are for variation in leaf form and color, especially variegated patterns. Many of the variations would be considered inconsequential by Western standards.
3. The selection of variants is not haphazard. Different kinds and degrees of variation have been classified and given names, and some are judged more desirable than others. Usually those aberrations which weaken a plant's constitution and increase its dependence on its grower's skill are most desirable.
4. The selections are always grown and displayed in pots, not in the garden. The traditional pot is of *raku* ware, a thin porous container fired at low temperature, with a rough surface and a shiny black glaze. The pots are decorated with a gold rim and feet (*fuchikin*), waves and birds (*nami-nishiki*), or elaborate patterns of flowers or fantastic animals (*nishiki*).
5. The selections are assigned names which are usually metaphorical, or sometimes allusions to places or events in classical Chinese history. These names are usually written in Chinese characters rather than the Japanese phonetic systems (*kana*).
6. The cultivars are evaluated by societies of hobbyists who deal with the selections of one species. The results of evaluation are periodically published on a chart called a *meikan* which resembles the traditional scoreboard (*banzuke*) of *sumō* wrestling.
7. Interest in the various groups is cyclical and has historically been accompanied by waves of intense financial speculation as prices rise in times of popularity.

The Cultivation of *Asarum*

The development of *koten engei* as a horticultural movement can be better comprehended by looking closely at one of the groups cultivated such as *Asarum* (wild ginger). Japanese awareness of *Asarum* dates to the beginning of Japanese history, as seen by the carved *Asarum* designs at the eaves of ancient buildings. These designs were thought to protect buildings from thunderstorms and earthquakes. The species of *Asarum* which is of most interest in the development of the selections, *Asarum takaoi*, grows in profusion at the approach to the grand shrine at Ise, the most revered of ancient *Shintō* shrines. *Asarum* can be seen growing in a variety of gardens in Kyoto where quiet, rustic, understated elegance characterizes the plantings. Its religious and ornamental importance is entwined with its medicinal properties, and it is still important in Chinese-style pharmacology. *Shintō* priests, like their Korean *shaman* predecessors, decorated their costumes and headdresses with *Asarum* leaves.

Koten engei in the U.S.

What does *koten engei* have to do with the All-American Gardener? Probably more than you realize. The development of the Japanese garden as a setting for mental repose, and the involvement in close-up cultivation of highly dependent plants have been successful in Japan in large part because of their role in "stress management" in crowded urban societies. Quiet retreats and "high-touch" horticulture are as relevant to American urbanites today as they were to ravaged *samurai* in Nagoya. Nurseries in California are beginning to grow and promote *koten engei* plants, and a book about *Raphis excelsa* cultivars has recently appeared in English. ☙

Drawings by Donald Emminger.
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THE TIE BETWEEN JAPANESE ARCHITECTURE AND GARDENS

Harriet A. Henderson

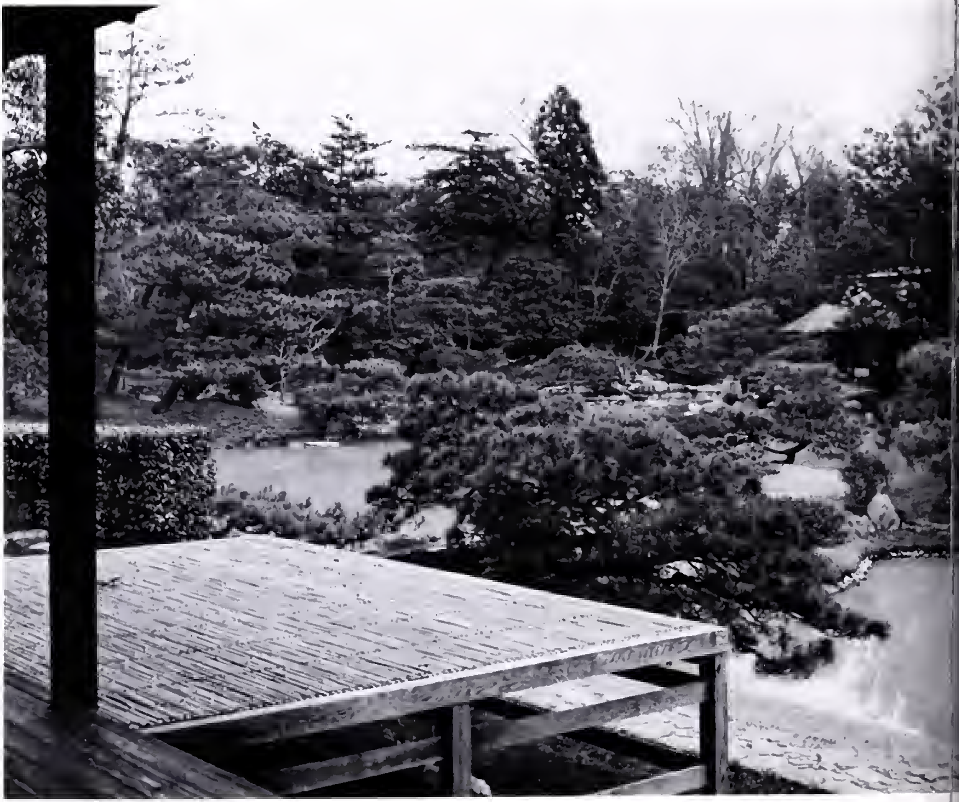
JAPANESE ARCHITECTURE and gardens are characterized by highly integrated indoor and outdoor spaces. This integration can be traced through the history of the development and design of Japanese buildings and gardens.

Historical Development

Shinto and Buddhist religions greatly influenced the form of Japanese gardens and architecture. To summon the Shinto *kami*, gods believed to dwell in mountains, rivers and throughout the natural environment, a holy space was prepared. Consisting of four wood columns marking a square on a plane of white sand, this sacred space influenced the development of Japanese dwellings and the dry landscape gardens known as *karesansui*.

The arrival of Buddhism in the 7th century brought Chinese architecture and city planning, with vermilion red buildings grouped symmetrically along north-south axes. Gradually, the Japanese assimilated and transformed these symmetrical arrangements to accommodate the natural mountainous topography. Buildings were

A raised wood veranda can be used as an extension of the living area or a part of the garden since it generally has no handrails. The natural wood used for its construction contrasts in texture to the interior.



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placed on diagonal axes, with the staggered structures creating spaces for gardens around each pavilion. As the vibrant Chinese colors were replaced with the natural Japanese wood surface on the structures, the formal Chinese courtyards gave way to more informal and asymmetrical Japanese gardens. Gardens in the 8th to 12th centuries typically represented a Buddhist paradise with a pond and flowering plants, and they were also enjoyed for boating and poetry readings.

During the 13th and 14th centuries, architectural innovations included *shoji* sliding doors (opaque paper panels within wood lattice frames) and *fusuma* (paper covered sliding panels, which were often painted). Rounded columns replaced the four square columns which established the corners of a room. Eventually, *tatami* (woven floor mats about 3 feet by 6 feet) were used as floor coverings, and the dimensions of the assembled *tatami* determined the overall shape of the room.

In the 15th and 16th centuries, Zen Buddhism reached the peak of its influence. With its emphasis on simplicity, Japanese architecture and gardens became increasingly subdued. In temples, rock and sand gardens with evergreen plants were preferred for contemplation and meditation. Designed to be viewed from the building in a kneeling or sitting position, some gardens expressed the stark beauty of Chinese landscape paintings, while others reflected the Zen asceticism through abstract compositions.

Following the Zen philosophy, founders of the tea ceremony modeled the tearoom after the rustic thatched roof farmhouse to create an atmosphere of seclusion from the rigid patterns of daily life. The path to the tearoom was designed to evoke the feeling of a journey to a mountain retreat. Out of this tradition, with its emphasis on the pathway and movement, developed the stroll garden in which pavilions, usually located around a pond, were linked by paths.

Throughout Japanese history, the design of the architecture and gardens has been influenced by the climate and the abundance of natural resources. To ease the humidity of the summers and the threat of earthquakes, the houses are elevated 1½ to 2½ feet above the ground on wood columns, with flexible partitions. The sliding screens are adjusted to create large or small open spaces according to the season and to frame views of the garden. Large overhanging roofs of clay tile, wood shingles or thatch provide relief from the sun and rain.

The enclosure of the house and garden by a wall or fence, the area under the eaves and the sliding partitions of buildings are three important features which illustrate how traditional Japanese buildings and gardens are integrated.

To create a private domestic space separated from the densely populated outside world, each lot is surrounded by an enclosing wall, fence or hedge that is above eye level. The house and garden are linked by the surrounding enclosure. The materials used reflect the natural resources readily available and set a tone of formality or informality. Stone walls and tile topped clay walls tend to be formal and architectural, while wood, bamboo, and reed fences vary from geometric to asymmetrical patterns. Hedges are often used in combination with open weave bamboo fences as a subtle transition from the garden to the enclosing edge. Berms also screen unwanted views while providing a change of topography within the garden.

The Japanese also enclose the garden to frame desired views with walls, fences, and plants. Focusing on a neighboring tree, nearby hill, or landscape feature gives the illusion of a larger garden by "borrowing scenery," or *shakkei*.

Another example of enclosure which links the building to the garden is the sleeve fence – a direct extension of the building. Made of bamboo and dried reeds, this fence has dimensions which are generally five to six feet high and three feet wide. The sleeve fence leads the viewer's eye from the building out into the garden, and it makes a transition in materials from the planned wood of the structure to the plants in the garden.

In the area under the eaves, the second important feature, the line of the roof overhang is repeated on the ground in stone, as a 12 to 18 inch wide gravel band edged with cut stone or rock. This run-off area for drainage is as decorative a part of the garden as it is a functional part of the house. Ornamental bronze or iron rain chains hung from the overhang corners act as vertical accents and allow rain water, dancing down the chains, to become a decorative garden element. As these gravel and stone bands follow the rectilinear building lines, a contrasting stepping stone path with an irregular pattern leads from the garden to the edge of the house. The stepping stone at the building entrance is used for placing shoes before entering the house, and it is larger and higher than the other stepping stones.

Traditionally, the wood columns of the house, and the posts supporting the overhang rest on stone bases to protect the wood from moisture. A natural rock or cut stone column base is often used today as a decorative transition from the architecture to the garden.

A raised wood veranda, typically under the overhang, can be used as an extension of the living area, or as part of the garden since it generally has no handrails. The bamboo and natural wood materials used for the veranda contrast in texture to the *tatami* and *shoji* of the interior, while harmonizing with the exterior rocks, plants, fences and stone walls.

When the space under the eaves is kept at ground level, it assumes even more of the character of the garden. A change of surface to cut stone or gravel often occurs in this intermediate area to indicate the transition from the exterior to the interior. In some cases there is a complete integration of house and garden with plants brought into the vestibule area as part of a flush planter or in containers. There, the steps inside signal the beginning of the interior spaces and the location to place shoes.

Screening devices, such as rattan blinds known as *sudare*, are often hung from the eaves to shield the veranda from sunlight or unpleasant views. They provide ways for the inhabitants to see or experience nature, while still protecting them from the elements.

In both the veranda and vestibule areas, moveable wooden shutters, glass panels, and *shoji* screens further blend the interior and exterior

The Katsura Villa Garden, Kyoto (property of the Imperial Household) demonstrates the integration of Japanese architecture and gardens. The transition from house to garden is from refined materials to rough hewn natural ones with asymmetrical patterns.

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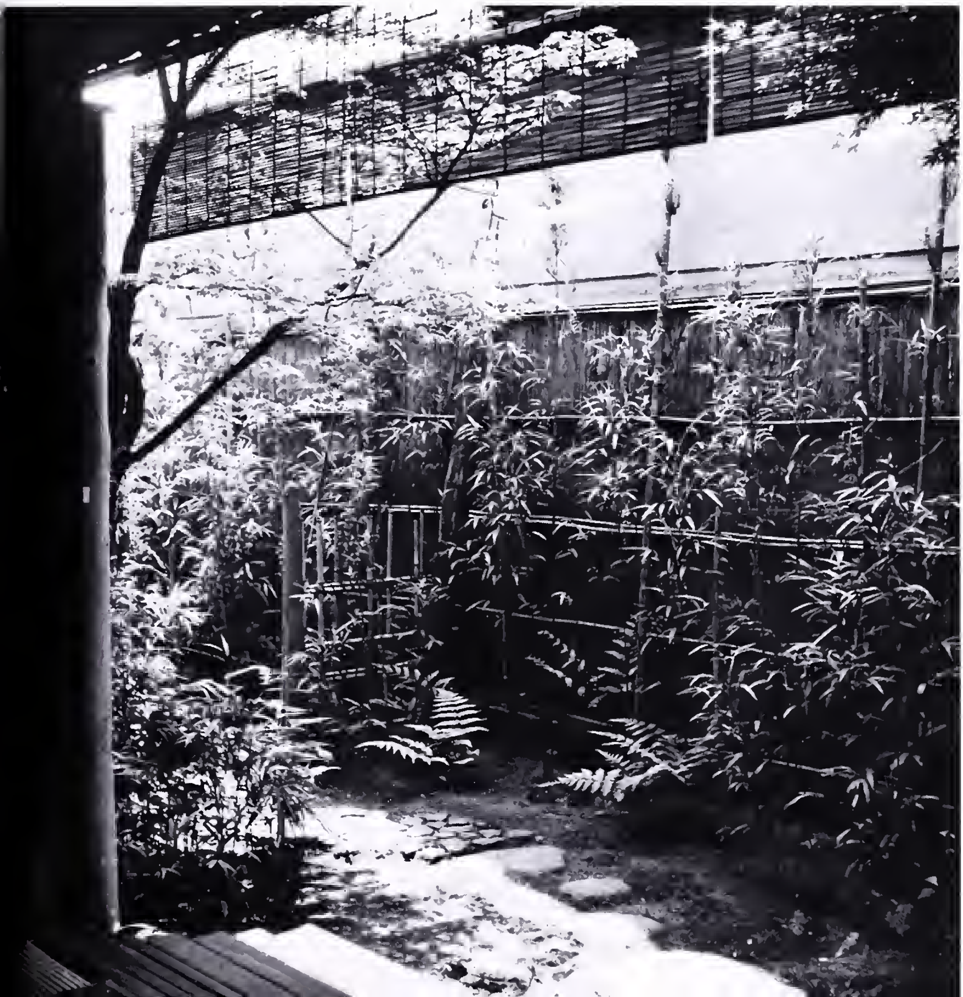
spaces. All of these sliding partitions extend from floor to ceiling, and when opened provide uninterrupted expanses for viewing the garden. The outer heavy wood shutters provide protection, privacy, and insulation at night, but they can be opened and stored in the wall during the day. Glass doors with wood frames provide views of the garden, while shielding the interior during inclement weather. The *shoji* can be drawn back to open an entire room to a garden panorama, with the interior wood hewn columns echoing the tree trunks in the garden. With equal ease, *shoji* can also be partially closed to frame a specific garden feature. When completely closed, the *shoji* transmit soft, filtered light, and the pattern of branch and leaf shadows cast on the sliding doors still reveals the presence of the exterior landscape.

The integrated design of Japanese architecture and gardens offers many interesting ideas on how to fuse houses and gardens. The transition from the house to the garden is made by moving from refined materials with architectural designs, to rough hewn and natural materials with asymmetrical patterns. Innovative ways of enclosing indoor and outdoor spaces are shown with an array of fences, walls, and partitions. An intermediate space of a veranda or vestibule extends the garden into the house, and the house into the garden. The flexible partitions, which delineate the space and views from room to room, and from room to garden, allows an openness and unity between the interior and exterior. ✤

The enclosure of the house and garden by a fence creates private domestic space separated from the densely populated outside world. The house and garden are linked by the enclosure.



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A view of a "residential forest" surrounding the Nyta Garden, Ibaraki Prefecture near Takahagi City. The main forest planting is composed of *Cryptomeria japonica*.

JAPANESE GARDENS—THE VIEW FROM THE WILDERNESS

John L. Creech

THERE IS A SPECIAL ASPECT of Japanese gardens that commands attention from the moment one sets foot through the garden gate. The array of plants evokes a feeling that each garden builder has a communion with nature. But what else would one expect from a people whose entire gardening tradition has been nature oriented.

From earliest times, the Japanese have been on intimate terms with their natural landscape both from a philosophical and practical viewpoint. That relationship was intensified by some 230 years of seclusion from about 1636 to 1868. During that era, the Japanese applied several centuries of Chinese influence to their own rich flora and added a devotion to detail that, in the case of garden plants and design, produced some remarkable results.

From scores of wild plants, hundreds of improved varieties were selected and described and, in the instance of azaleas, over 300 selections appear in the *Kinshŭ Makura*—the first book written on this popular garden plant in 1692. In 1845, a samurai, Matsudaira Sakinko, wrote the first basic book on *Hana Shōbu* (*Iris kaempferi*). He discussed how he found his first seedlings in the mountains near Fukushima (probably the Adzuma mountains), and he described details of culture, fertilization, how to raise seedlings and control beetle damage to the flowers.

Hundreds of books on the ennobling of wild ornamental species appeared during this period. Some are simple discussions of single plants, others are practical guides to the culture of

Black pines, sculptured by the winds, along with daylilies and Kaempferi azaleas still flourish on picturesque islands which have been cut off from the mainland of northern Honshu island.

All photos courtesy of John L. Creech

flowering plants, and still others are complete encyclopedias, such as one with 96 volumes covering a range of subjects from medicinal plants, poisonous plants (azaleas are included here), the economic plants to ornamental and forestry species. Books on bonsai and flower arrangement were common as were those discussing how to use plants, stones and water in the garden.

It is no accident the Japanese were drawn to their wilderness. The mountainous terrain demanded that crop production areas be close to the forest, and farmers drew upon these natural resources for fuel, timber, medicine and food supplements. Gradually planted forests displaced natural stands and *sugi* (*Cryptomeria japonica*) occupied the lower and more favorable sites while hinoki cypress (*Chamaecyparis obtusa*) was planted on higher and drier locations. The change was so gradual that probably little of the native flora was permanently displaced as a walk in an old *sugi* forest will show. In addition, shrine and temple forests tended to rely on the natural stands of trees and afforded protection to other plant life. Giant bamboos introduced from China at an early era appeared in the company of the native tree species to form a close knit support system for the farming population. As they worked in the forests or climbed the volcanic peaks in search of religious truths, the highly observant people collected attractive and unusual forms of flowering plants to enhance their temples, shrines and gardens. Being equally adventuresome businessmen, many farmers began to grow seedling trees and shrubs to replenish the forests and to provide plants for the feudal nobility who were engaged in beautifying their castle grounds. For example, when Edo (Tokyo) was destroyed by fire in 1657, the Shōgun decreed that there be a massive tree and shrub planting program to revitalize the city. Many farmers around Kawaguchi and Angyo, just north of the city, became engaged in the nursery business to meet this demand for plants and thus began the famous nursery center which exists today.

These opportunities came about partly as a result of Japan's exceedingly rich flora of over 5,000 species of higher plants and the fact that broadleaved evergreens and conifers are major components of this flora. These are distinguished through a range of natural landscapes, from exquisite coastal barrens with windswept pines, a mixture of broadleaved trees and shrubs, and carpets of junipers, to rugged mountain panoramas with grand associations of azaleas, camellias and hollies which draw vast audiences of viewers.

The Japanese are so infatuated with these scenes that ship captains pass close to small islands in the Inland Sea so passengers may enjoy an appropriate view. But the variation is endless and no matter how many times one makes the journey to Japan, new adventures into the world of plants are in store.

Knowing about the natural landscapes of Japan is an aid to appreciating the Japanese garden, since native species have been used almost exclusively in their development.

Origin of Japan

According to legend, the islands of Japan were derived from the activities of the Gods who enjoyed life in the Plain of High Heaven, among whom were Izanagi and Izanami, husband and wife. Among his many heroic gestures, Izanagi once threw his jeweled spear into the deep and as he withdrew it, a shower of brilliant drops fell from the spear to become the verdant dragon-shaped island group we call Japan.

In a hidden village in northern Honshu island (along the Pacific coast), the last colonies of *Camellia japonica* cling to the steep cliffs.

Instead of showering down, the islands were thrust up from the Pacific Basin as the peaks of submarine mountains that arose over a period of 60 million years from one of the deepest trenches in any ocean basin, with depths reaching 30,000 feet. In an unstable region, Japan experiences numerous volcanic eruptions and earthquakes.

Because of this dramatic origin, Japan is immensely rugged, consisting of over 75% mountains and hills with steep slopes. Although the mountains are not especially high (Mt. Fuji being the highest at 12, 461 ft.) there are dozens of mountains above 10,000 feet elevation, especially in the Japan Alps. These mountains are covered with luxurious forests and this green mantle is one of the lasting impressions of Japan. Because of Japan's unique geography, as an island chain running somewhat north-southwest off the coast of Asia, a moderate climate with ample rainfall prevails and the cool mountains contain a high proportion of broadleaved evergreens, trees, shrubs and groundcovers. Therefore all of the main elements essential to the Japanese landscape garden were readily available and in combinations that were often copied by the garden builders.

Wilderness Areas

The main sources of landscape materials are now preserved in the modern national park system of Japan and it is there one finds the natural landscape beauty reflected in gardens. There are 19 national parks and an additional 20 prefectural, or quasi-national parks, and 3 national gardens, the latter being the Imperial Palace Outer Garden, Shinjuku Gyoen and Kyoto Gyoen.

A trip to some of these areas will provide the gardener and traveler alike with background and ideas. The range of plant materials, outstanding landscapes, mountains and rocky coastlines seem endless. Visits to forests will reveal many remarkably fine plants not necessarily used in Japanese gardens and yet of interest. Beach areas are often covered with daylily species blooming in the summer. But the evergreen aspect of warmer Japan is gone.

There are so many treasure spots in Japan that many trips are essential to complete the story and witness the beauty of the four seasons as they relate to the Japanese garden. Fortunately the conservation system in Japan and the extent of these natural treasures assures that they will exist for a long time. ✣

Machilus thunbergii, here in close-up, is a broad-leaved evergreen tree. The bark is smooth in texture and light grey in color.

This tree is growing on the sea cliff above Ayukawa, Miyagi Prefecture, Honshu.

RECOMMENDED PLANTS FOR JAPANESE GARDENS IN AMERICA

Stephen A. Morrell

LISTED BELOW are plants that are both native to Asia and North America with an emphasis on NE Asia and E N. America as these two temperate floras are very similar with many identical species and related counterparts.

Using native plants of your area in addition to Japanese plants as a blending of two harmonious floras is in keeping with Japanese garden ideals.

This representative list is certainly not all-inclusive; varieties and cultivars are endless. In all cases a plant's hardiness rating should be considered for your area, as well as other cultural requirements.

Evergreen Groundcovers	**Common Name**	**Comments**—Nativity
Arctostaphylos uva-ursi	Bearberry	Eur., N Asia, N. Amer.
Asarum shuttleworthii 'Callaway'	Wild ginger	SE U.S.
Galax urceolata	Wandflower	SE U.S.
Leucobryum glaucum	Cushion moss	Circumboreal
Liriope muscari	Lilyturf	Japan, China; numerous cultivars
Pachysandra terminalis	Japanese spurge	Japan; *P. procumbens* is an American counterpart
Polytrichum commune	Hairycap moss	Circumboreal
Sarcococca hookerana var. *humilis*	Sweet box	China
Decidious Groundcovers		
Hosta lancifolia	Narrow-leaved plantain lily	Japan
Hosta plantaginea	Fragrant plantain lily	Japan
Hosta sieboldiana	Plantain lily	Japan
Maianthemum canadense	Canada mayflower	Canada S to IN & W to NY; a Japanese mayflower is *M. dilatatum*.
Petasites japonicus	Fuki	Korea, China, Japan; petioles are eaten as a vegetable in Japan.
Perennials		
Anemone x *hybrida*	Japanese anemone	Japan, China
Arisaema triphyllum	Jack-in-the-pulpit	Many Japanese counterparts.
Equisetum hyemale	Horsetail	Eurasia, Pacific N. Amer.

Evergreen Groundcovers	Common Name	Comments—Nativity
Erythronium americanum	Dogtooth violet	American counterpart to Japan's *E. dens-canis.*
Iris cristata	Crested iris	SE U.S.
Iris kaempferi	Japanese iris	Japan; numerous cultivars.
Iris pseudacorus	Yellow flag	W. Eur., N. Afr.; naturalized in N. Amer.
Polygonatum biflorum	Solomon's seal	N. Amer.
Polygonatum odoratum	Solomon's seal	Japan
Rodgersia aesculifolia	Bronzeleaf	China
Trillium erectum	Purple trillium	Many Japanese counterparts.
Ferns		
Adiantum pedatum	Maidenhair fern	N. Amer. & E Asia
Athryrium felix-femina	Lady fern	Temperate Northern Hemisphere
Athryium goeringianum	Japanese painted fern	Japan
Dryopteris erythrosorus	Japanese shield fern	China, Japan; *D. marginalis* is an American counterpart.
Polypodium virginianum	Rock polypody	E N. Amer.
Polystichum acrostichoides	Christmas fern	E N. Amer.
Bamboo & Ornamental Grasses		
Arundinaria pygmaea	Kenezasa	Japan
Arundinaria variegata		
Arundinaria viridi-striata		
Sasa veitchii	Kumazasa	Japan—popular in gardens.
Sasa palmata		Japan, Sakhalin
Shibataea kumasaca	Okame-zasa	Japan—common in gardens.
Phyllostachys aureosulcata	Yellow groove bamboo	China
Phyllostachys nuda		China
Sinarundinaria nitida	Fountain bamboo	China
Thanocalamus spathaceus	Umbrella bamboo	China
Miscanthus sinensis 'Gracillimus' 'Strictus'	Susuki	E. Asia, naturalized in some E. states
Pennisetum alopecuroides	Fountain grass	Asia

Evergreen Groundcovers	Common Name	Comments—Nativity
Aquatics		
Nelumbo nucifera	Lotus	Orient; edible rhizomes & seeds; sacred to Buddhists.
Nymphaea sp.	Water lilies	Use hardy types
Vines		
Hydrangea anomela subsp. *petiolaris*	Climbing hydrangea	Japan, Taiwan
Parthenocissus tricuspidata	Boston ivy	Central China, Japan
Wisteria floribunda	Japanese wisteria	Japan
Evergreen Shrubs		
Abelia x *grandiflora*	Glossy abelia	China; semi-evergreen.
Buxus microphylla	Littleleaf box	Japan
Camellia japonica	Camellia, Tsubaki	Japan; S. Korea, Taiwan
Cryptomeria japonicus 'Elegans Nana'		A dwarf cultivar of this tree.
Ilex crenata 'Helleri'		
Ilex x *meserveae*		
Ilex pedunculosa	Longstalk holly	Japan
Juniperus spp.	Juniper	Many species & cultivars are appropriate.
Kalmia latifolia	Mountain laurel	E N. Amer.
Leucothoe sp.		*L. fontanesiana* is a SE U.S. native.
Mahonia bealei	Leatherleaf mahonia	Confused in cultivation with *M. japonica*, a Chinese species cultivated in Japan.
Photinia glabra	Japanese photinia	Japan
Picea abies 'Nidiformis'	Dwarf Norway spruce	Low with a dense head.
Pieris japonica	Japanese pieris	Japan
Pinus strobus 'Nana'	Dwarf white pine	
Rhododendron keiskei		Central Japan
Rhododendron makinoi		Japan
Rhododendron obtusum	Kurume azalea	Japan; numerous cultivars.
Rhododendron smirnowii		Caucasus
Rhododendron yakusimanum		Japan

Evergreen Groundcovers	Common Name	Comments—Nativity
Skimmia japonica	Japanese skimmia	Japan
Taxus baccata 'Repandens'	Weeping English yew	
Tsuga canadensis 'Pendula'	Weeping Canada hemlock	
Deciduous Shrubs		
Acer palmatum var. *dissectum*	Cutleaf maple	Japan; numerous cultivars.
Berberis thunbergii 'Crimson Pygmy'	Dwarf Japanese Barberry	Japan
Callicarpa japonica	Japanese Beautyberry	Japan, China
Clethra barbinervis	Japanese clethra	Japan; *C. alnifolia* is an American counterpart.
Corylopsis pauciflora	Buttercup winterhazel	Japan
Corylus avellana 'Contorta'	Harry Lauder's walking stick	Europe
Cotinus coggygria	Smokebush	S Eur. to Asia
Cotoneaster horizontalis	Rockspray	W China
Enkianthus perulatus		Japan
Ilex verticillata	Winterberry	N. Amer.
Lespedeza bicolor	Bush clover	Japan
Nandina domestica	Heavenly bamboo	India to E Asia
Paeonia suffruticosa	Tree peony	China, Bhutan to Tibet; many cultivars.
Rhododendron mucronatum	Snow azalea	Japan
Rhododendron schlippenbachii	Royal azalea	Manchuria, Korea, Japan
Viburnum plicatum var. *tomentosum*	Doublefile viburnum	China, Japan
Deciduous Large Shrubs —Small Trees		
Acer griseum	Paperbark maple	China
Acer palmatum	Japanese maple	Korea, China, Japan
Amelanchier canadensis	Shadblow	Quebec to GA
Cornus kousa	Japanese dogwood	Japan, Korea
Cornus mas	Cornelian dogwood	Eur., W Asia
Davidia involucrata var. *vilmoriana*	Dove tree	W China
Hamamelis mollis	Chinese witchhazel	W China; American counterpart: *H. virginiana*.
Magnolia stellata	Star magnolia	Japan
Magnolia x *loebneri* 'Merrill'	Loebner magnolia	

Evergreen Groundcovers	**Common Name**	**Comments—Nativity**
Prunus maackii		E Asia
Prunus mume	Japanese apricot	E Asia
Prunus serrulata	Japanese flowering cherry	E Asia
Prunus subhirtella 'Pendula'	Weeping Higan cherry	Japan
Oxydendrum arboreum	Sourwood	PA to IL, S to FL
Salix matsudana 'Tortuosa'	Corkscrew willow	
Stewartia pseudocamellia	Japanese stewartia	Japan; American counterparts: *S. ovata* & *S. malacodendron*
Styrax japonicus	Japanese snowbell	Japan, China; American counterparts: *S. grandifolius* & *S. americanus*
Virburnum sieboldii	Siebold viburnum	Japan
Evergreen Trees		
Chamaecyparis obtusa	Hinoki false cypress	Japan; numerous cultivars.
Cryptomeria japonica	Japanese cedar, Sugi	Japan; numerous cultivars.
Ilex opaca	American holly	N. Amer.
Ilex pendunculosa	Longstalk holly	China, Japan
Pinus bungeana	Lace-bark pine	NW China
Pinus densiflora 'Umbraculifera'	Tanyosho pine	Japan
Pinus koraiensis	Korean pine	Japan, Korea
Pinus parviflora	Japanese white pine	Japan
Pinus strobus	White pine	N. Amer.; various dwarf cultivars.
Pinus sylvestris	Scotch pine	Eurasia
Pinus thunbergiana	Japanese black pine	Japan
Sciadopitys verticillata	Japanese umbrella pine	SW Japan
Deciduous Trees		
Acer rubrum	Red maple	U.S.
Cercidiphyllum japonicum	Katsura tree	Japan, China; leaves fragrant in autumn.
Ginkgo biloba	Maidenhair tree	Frequently seen at temples in Japan.
Koelreuteria paniculata	Goldenrain tree	China, Korea, & naturalized in Japan
Metasequoia glyptostroboides	Dawn redwood	China
Nyssa sylvatica	Sourgum, tupelo	E N. Amer.
Prunus yedoensis	Yoshino cherry	In cultivation in Japan; unknown in the wild.

MOSS GARDENING

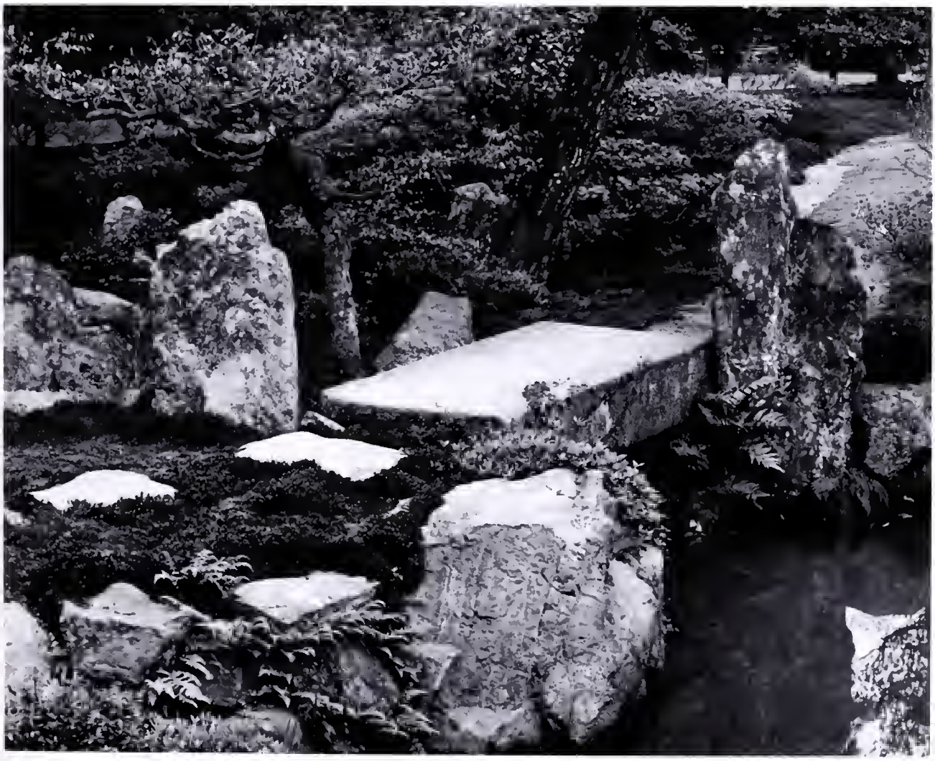
Michael B. Trimble

GROWING MOSS ORNAMENTALLY is not a widely accepted practice in American gardens. Unstinting efforts and considerable sums of money are spent annually to eradicate these diminutive plants. Sadly, we have come to automatically equate the presence of moss with horticultural inadequacy in the garden. Persuading fellow gardeners to reconsider the ornamental potential these plants embody is a challenge.

Mosses, along with lichens, were among the first plants to establish themselves upon the barren rock of the early land masses left in the wake of receding oceans, but their ability to grow where little else will, while worthy of our admiration, has instead earned them a reputation as weeds. Favoring spots where shade and dampness thwart the growth of grasses and flowering plants, the presence of moss is taken as an indication that such spots are culturally deficient, further adding to our tendency to regard them as undesirable garden inhabitants.

How differently we look upon the mosses in nature that cluster at the bases of trees in a shady woods, or cling tenaciously to the rocky faces of boulders. Frequently mosses and lichens will share a rocky cleft or moist recess among the roots of an old tree, their varied shapes and colors providing a visual feast to the observant. The lush, moist greens, grays and even whites of a moss-strewn stream bank or moist woodland floor evoke an appreciative response—mosses are certainly not weeds! In their native

All photos courtesy of Brooklyn Botanic Garden



Moss carpets the area between the stepping stones leading to the bridge which is one large stone. Other lichen covered rocks interplanted with ferns complement the area.

habitats they personify the gentler, more pacific side of our natural surroundings. They contrast with the rugged character of rocky crags and mountain tops, the dignity of mature trees, and blend with the fluid energy of streams and cascades. In their natural settings mosses please the eye without rousing feelings of disdain.

In Japan, nature has been taken as the guide in the creation of both public and private, religious and secular gardens. Replication is rarely the aim of a garden maker, but instilling some feeling of the spectacular natural beauty of Japanese islands within the garden is the desired goal. Their serene character and ability to blend harmoniously with rock, water and plants used in creating a garden have earned them a favored status among Japanese gardeners. Looking upon an expanse of moss as it runs in among the roots of trees or up to the rocky edge of a stream or waterfall, one can easily appreciate the ornamental usefulness possessed by these agreeable little plants.

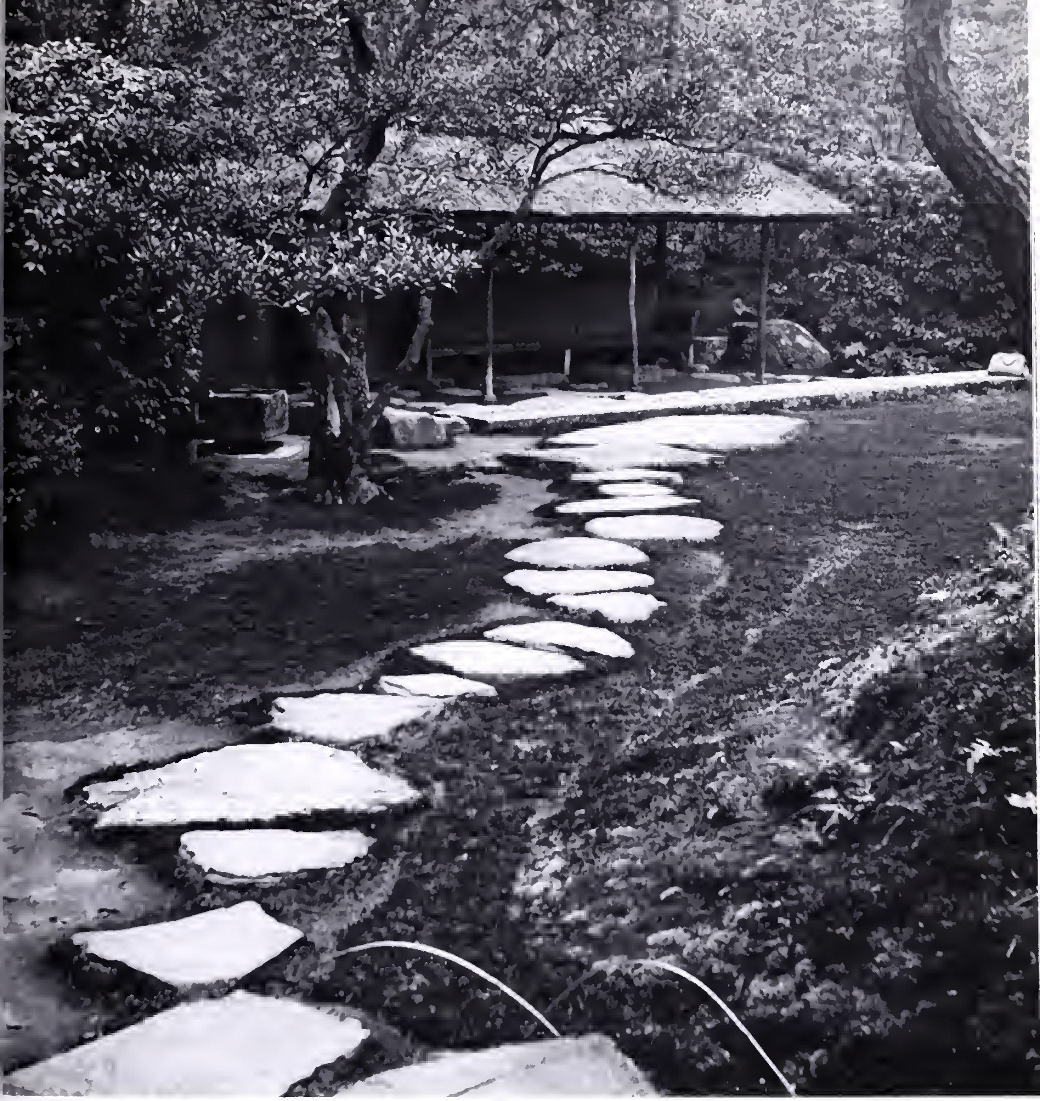
Moss Botany

Mosses lack true roots and vascular tissues which trees, shrubs and flowering plants possess. Instead they have primitive, root-like structures called rhizoids which anchor a moss plant to its chosen home, while the task of taking up moisture is shared by nearly all surfaces of a moss that come in contact with water.

Mosses also differ from most garden plants by their reproductive cycle. Taking the hairycap moss, *Polytrichum commune*, as an example, the soft green carpets of small plants we recognize as moss are made up of sexual, or gametophytic representatives of species. Each individual will spawn both male and female gametes. The gametes meet and fuse if the moss is cloaked in sufficient moisture for the male gamete to move from its point of origin to where the female gamete is formed. This assures the development for the alternate, sporophytic generation.

The sporophytic, or asexual generation, is represented by a spore producing capsule normally on a stalk that remains attached to the gametophytic parent. From the spore produced in the capsule, the next gametophytic generation will germinate, which we again recognize as moss. Their interesting means for achieving sexual reproduction is surprisingly efficient, belying their apparent vulnerability.

Shaded area beneath a large tree creates an ideal growing area for moss. It grows over roots in tufts and mounds. Leaves which have fallen add magic to the landscape.



Stepping stones of irregular shape are placed here in a meandering pattern. Moss grows in between the stones and under the trees. This is one of a number of lovely vistas at Katsura Villa, Kyoto.

Botanists have identified upwards of 14,000 species of moss, with species adapted to such varied habitats as moist and shady, dry and sunny, soil dwellers, wood dwellers and those that prefer solid rock. Most are easily grown. However, to grow them well one must take the time to match a given species to its desired growing conditions.

Most mosses likely to be used in the garden thrive where soils are moist year round, shade is plentiful during the summer and the soil is acidic. Mosses found growing on wood or stone can be used as well, with best results coming when the mosses and their chosen home are moved together into the garden.

Mosses are tough. They can suspend their growth processes, entering a state of dormancy, when the conditions of their environment do not favor continued growth. Severe cold, heat, or drought can all be endured.

If suitable shade and moisture are available, mosses can be used in many spots where lawn grasses fail and herbaceous groundcovers can't get established. Mosses are an excellent contrast to both stone and wood and can be used advantageously in shady rockeries or to cloak the ground left bare by the greedy roots of shallow rooted shade trees. Their tendency to go dormant as their surroundings dry can be off-set with an occasional watering. Having no true roots, such waterings need not be deep.

Moss lawns are becoming popular where excessive shade thwarts the use of lawn grasses. A close look at your own lawn will probably reveal a wealth of mosses intermingled with the grasses where trees cast their shade.

If hairycaps dominate the mosses already present, steps to acidify the soil may be all that is needed to encourage their dominance of the entire area. Dusting with sulfur to lower the soil's pH to a level of 6.0 or less will usually do the trick. Weeds less finicky about pH must be removed manually.

Simple steps are needed to introduce mosses into a garden. First, be sure the site offers growing conditions that will foster their vigorous growth. Secondly, prepare the site by removing all non-moss growth that might interfere with their later care and appearance. Lichens, ferns and wildflowers all belong to the group of plants I would leave in place while grasses and groundcovers such as pachysandra and ivy should be removed. Mosses do not need fertile soil and its presence often hinders moss by encouraging the growth of weeds. Good moisture retention is desirable and steps to improve a soil's tilth will benefit a moss planting over the long run.

The most straightforward way to bring mosses into the garden is to transplant moss sods. The usual source will be colonies growing wild which will provide the opportunity to observe their growing conditions first hand. Emulating their preferences will help assure success in the garden. In Japan, moss sods can be purchased much like turf for landscaping new gardens.

When collecting mosses from the wild take only what is needed and leave as much as possible undisturbed to insure that the native colonies will continue to prosper. Mosses are tough and can re-establish themselves quickly, however, excessive collecting can imperil both the diversity and vitality of native moss colonies, especially those growing in exposed locations.

With the sods in hand and their new home properly prepared, moisten the sod and planting area and set the sod firmly in place. Given ample moisture, the moss' rhizoids will readily anchor the sod and the colony will slowly begin to expand outward. The cool days of spring and autumn are best suited to moss transplanting. In addition, the absence of tall grasses and other herbaceous plants at these times will make it easier to spot the mosses you want.

Mosses can also be introduced by means of spores. However, this is a more labor-intensive method and less reliable as it gives weeds a better chance to move in before the mosses do.

Mosses are also capable of regenerating themselves from bits and pieces dislodged from an actively growing or dormant plant. Gather pieces of moss, dry them and then spread the powdered bits over moist soil. This method has the drawback of leaving the young plants vulnerable to weeds and weather. However, it can be a useful means for getting moss to grow in tight spots where it is difficult to anchor sods.

The care of moss planting involves little more than 1) watering when needed, 2) weeding, and 3) keeping leaves off the moss in winter. In Japan, expanses of moss are swept regularly while the maritime climate can usually be relied upon to keep them well watered.

Recommended Species

The most popular and perhaps the best moss for covering large areas is the hairycap (*Polytrichum commune*). Its dark green tint and soft, needle-like appearance offers a most appealing substitute for grass. Its uniform height never needs mowing, insects and diseases are no problem and most weeds can be discouraged by acidifying the soil.

The common fern moss, *Thuidium delicatulum* is another splendid addition to a moss planting. Its delicate, light green, feather-like form is effective at the base of gnarled roots or skirting in among a grouping of lichen-encrusted stone. The greenish-white tufts of the pincushion moss, *Leucobryum glaucum*, is a useful contrast while the windswept appearance of the broom mosses, *Dicranus* spp., make fine additions to the garden. The happy-to-grow-just-about-anywhere cord moss, *Funaria hygrometrica*, will readily fill in where needed.

The beauty we see in them in their native settings can be transferred into the garden through careful attention to garden design and site preparation, with the gardens of Japan serving as vivid examples of how it can be done.

BAMBOOS AND JAPANESE GARDENING

Kim Sorvig

There are bamboos
ten thousand meters high
if you look at their shadows by moonlight.
Su Tung-P'o (1037–1101, China, Sung dynasty)

BAMBOO is a state of mind. To use it effectively in a garden, especially a Japanese garden, it is not enough to know how to grow it. That is in many ways *less* important than having a feel for bamboo's history, evocative power and cultural import. Bamboos have long shadows indeed, for they are the most useful group of plants known to humankind and are as mysterious and mystical as any living thing on earth. Whether cast by the moonlight of intuition or the stark light of scientific study, a sense of these ten-thousand-meter shadows help give bamboo its proper place in a garden.

There are excellent Japanese gardens which lack a single *living* bamboo, but even in the stone garden of Ryoanji, there are elements *crafted* of bamboo. In fact, in Japan and China, bamboo is so much a part of the fabric of life, it seems there would hardly have *been* any Oriental culture to give birth to such gardens, without the influence of the giant grasses.

The Kingdom of Bamboo

Bamboos are a large subfamily of the Grasses, woody and often giant. Their natural range centers in Asia, ('bamboo' is a Malay word), but includes Africa and the Americas. They range in size from 100-foot-tall giants to tiny ground-creepers, and grow in habitats from jungle riverbank to the high Himalayas. About 45 genera have been named, making several hundred species.

Mysteries surround the bamboos, and one need not be a botanist to experience this. Very little can equal the radiantly dim light inside a bamboo forest, the subtle colors from waxy white through yellow, green, to purple and black, the graceful columnar stems, and the sound of leaves rustling in the air and underfoot. Flexible yet indomitable, it is small wonder that bamboo is one of the three plants (with pine and plum) that symbolize the essential virtues in Japan. Even a small planting has something magnetic about it.

Besides inspiring wonder in lay-people, bamboos almost seem to *exist* to confound botanists! These "trees" are actually grasses, their "culms" (stems) hollow and segmented by "nodes" or joints, at which branching occurs. They are woody, but do *not* grow by annual rings. Their evolutionary history remains a conundrum: while their modern center of distribution is Asia, recent studies indicate that their nearest living relatives may be small, non-woody grasses now known mainly in the New World. Ecological jacks-of-all-trades, they adopt almost every kind of survival strategy, as canopy, understory, shrub, ground layer, or even vine; few plant families show such wide adaptability. This great diversity of form is unusual in a group whose reproduction is normally *vegetative*; besides, their chromosomes show *little* variability! As for their flowering, it is a subject for both botanical and mythological research!

Evolutionary relics themselves, the giant pandas have a particular interest in bamboo's flowering, as do gardeners. Many bamboos grow for 30–120 years before ever flowering. Some flower once and die. There have been reports that these cycles are synchronized for every bamboo of a species, even when transplanted continents from "home." *Some* of this is possibly myth; it is definitely not true for all species. Many garden specimens are clones of a single parent, which may explain some cases of synchronous flowering. But the mystery, and the consternation it causes, remains.

For a plant competing in an ecosystem, either fast growth or the strength and height provided by woodiness can help. But it is a rare plant that

Kim Sorvig

can do *both*: only very soft tissue can grow fast, but soft stems cannot reach great heights. The bamboos have solved this paradox rather neatly. The solution? A tight "sheath," a leaflike structure which wraps around each growing segment of the culm so tightly that it can *only* grow upwards. And grow they do: some species up to 40" a day, fast enough to stand and watch. Once the culm stops growing, becomes woody, and can support itself, the culm-sheath drops away. The side-groove typical of bamboo stems is formed by 'extrusion' as the culm pushes past a branch-bud held tightly in place by the sheath.

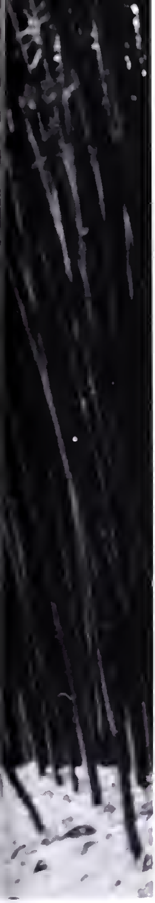
Traditional Garden Uses of Bamboo

The many uses of bamboo in traditional Oriental gardens reflect its ecological diversity. Trees, shrubs, or groundcover: bamboo fills many niches, in design as in nature.

The larger bamboos make wonderful forests, 100 feet tall and covering many acres, with little undergrowth and an open, lively feeling which suggests the interior of Japanese houses. In the largest palace gardens, such forests divide or frame whole landscapes, and form groves through which to walk among the foot-thick jointed stems (culms).

Medium-size bamboos (10–50 feet) are far more common in U.S. gardens. These can form screens or stand alone as featured plantings. They are also used as understory with deciduous canopy trees (but not with the larger bamboos). Being mostly evergreen, they are useful as a backdrop and for winter interest. Their vertical culms make a striking accent, especially effective in tiny courtyards or reflected in water.

The small bamboos serve as shrubbery, groundcover and hedges, often clipped. They too have a variety of textures and are usually evergreen. Small and medium-sized species can be planted as half-hardy perennials in colder zones, and also grown in containers.



A mature bamboo forest is difficult to imagine in proper scale, but this photograph will be of assistance. This is the entryway to Bambuseraie de Prafrance in Anduze, France. The arch is a railroad bridge.

The textural variety of bamboo finds great expression in Japanese gardens. Their form may be upright or arching, with few or many branches, straight or zig-zag; leaf size, shape, density, and color vary; the new sheaths are tufted, finely hairy, ribbed or smooth. There are a number of "abnormal" forms, such as the Tortoise-shell and Buddha's-belly bamboos, in which the internodes swell and contort into fantastic shapes. Almost every color except bright red can be found among bamboos which are sometimes striped or spotted.

Without bamboo as construction material, the gardens of the East would be much impoverished. Fences of whole or split canes, woven or tied or pegged, trip-rails of bent split canes, posts, gates, handles—all are common, in hundreds of designs. Bamboo can be steamed and bent into almost any shape. It is often inserted into plaster walls to frame or divide an opening.

Two very traditional Japanese constructions for the garden are the *tsukubai* water basin, and the *shishi-odoshi* or "deer-scarer." The *tsukubai* may be fed through a bamboo pipe musically dripping water and include a bamboo scoop for drinking or washing. The water scarecrow is always made of bamboo constructed from a large culm, set on a pivot and driven by water. It makes a resonant, eerie booming sound that echoes through the garden.

Cultivating the Bamboo

All bamboos grow from rhizomes; from buds on these grow the culms (also called 'canes,' a term better reserved for dried bamboo). Each culm gains full height and diameter in ONE season, unlike trees. It will harden, still alive, for several years, and if not harvested will die standing.

Based on the way their rhizomes spread, bamboos are classed as "clump-forming" or "running," an *extremely important* distinction when selecting them for a site.

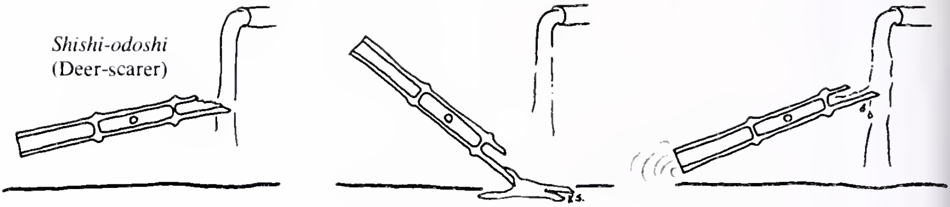
CLUMP bamboos tend to form dense, slow-spreading stands with culms close together. Their rhizomes are rather short and stout. Mainly of tropical origin, they shoot when rains follow a dry season, usually in summer or early autumn in the US. Few are frost hardy. *Bambusa* and *Dendrocalamus* are main clump genera grown.

RUNNING bamboos tend to have long, slender rhizomes, resulting in a more open stand and more invasive habits. Represented by *Phyllostachys*, *Sasa*, and *Arundinaria*, they are native to temperate climates, and therefore sprout in response to spring warmth. They are relatively hardy, and few are happy in year-round warmth.

Two misconceptions about bamboo are common causes of problems: one, that they are all heat-loving, and two, that they like swampy soils. There are bamboos hardy to −20° F, and wind- and sun-scorch strongly affect hardiness. And they will NOT tolerate waterlogging, which suffocates and rots the rhizomes. Excellent drainage is probably more important than plentiful water, though that is usually needed too.

Selecting Bamboo Species

Availability: Bamboos are usually sold as container nursery stock. The American Bamboo Society (ABS) compiles an updated list, at present showing 95 species and 22 suppliers in the USA. The list is free for a self-addressed stamped envelope. Importation of



Shishi-odoshi (Deer-scarer)

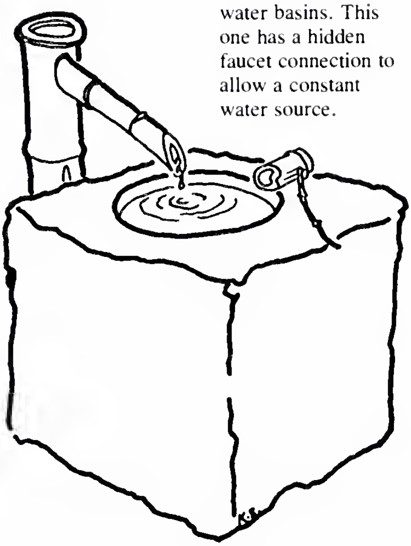
(1) Bamboo two-and-one half nodes long, on a pivot; the short end fills with water and drops.

(2) Water spills out and the long end is once again heaviest.

(3) Long end falls, strikes the ground and resonates. Water refills the short end.

bamboos from abroad could bring in grass-family diseases that endanger major cereal crops and is prohibited by quarantine regulations.

On Naming: One problem in obtaining bamboo is the jumble of names by which they are known. Many species have no common name in English. Flowers, on which scientific names are based, have rarely been observed, in some species never, so experts disagree on Latin names. Nurserymen and collectors are understandably confused so everyone adopts some compromise. In this article, the names used in the ABS list are followed for convenience.



Tsukubai with bamboo plumbing and water scoop or ladle. There are many types of water basins. This one has a hidden faucet connection to allow a constant water source.

Hardiness: In general, the true clump bamboos are injured or killed by 0°F, some by 5°; a few can take −10°. The running bamboo will survive between 0 and −10° on average. Rhizomes may survive much colder winters than culms, and sprout anew each year, as half-hardy plantings.

Where hardiness is crucial, *Phyllostachys nuda, P. flexuosa, P. aureosulcata, Sinarundinaria nitida, Pseudosasa japonica* and the *Sasas* are most reliable.

Invaders: These species are particularly invasive and should always be contained unless space is unlimited: *Arundinaria anceps, A. vagans, A. pygmaea, A. variegata, A. viridistriata; Sasas*, especially *S. palmata*; under good conditions *Pseudosasa japonica*; and most *Phyllostachys* given time, though less so than the above.

Substitutes & Imposters: "Sacred-, heavenly-, or Flowering-bamboo," *Nandina domestica*, is a Chinese relative of barberry, not a bamboo. Its foliage is vaguely bamboo-like, attractive as a substitute or in its own right.

Many reeds, pampas, grasses, etc. (including *Arundo*, not to be confused with *Arundinaria*) can give bamboo-like effects in areas where bamboos cannot grow.

"Mexican Bamboo" is *Polygonum cuspidatum*. This extremely invasive weed should only be considered as a bamboo substitute in very harsh climates; elsewhere it is uncontainable. It does resemble a 3-8′ bamboo at first glance, but it is related to buckwheat. "Mexican Weeping Bamboo," however, is a true bamboo, *Otatea aztecorum*.

Establishment, Care and Problems

Planting and Routine Care: Select or create a well-drained, moist location, fertile and sheltered from strong wind – the smaller the species, the more shade, as a rule of thumb. Drainage is essential and poor drainage should be improved to the depth of 18–24 inches by adding gravel to subsoil and sand to topsoil. The water table should be at least 18 inches below the surface. High nitrogen fertilizer is beneficial. Build containment structures if needed.

For even stands, bamboos should be spaced at about half their mature height. Refirm the soil. Planting depth should match the old soil mark (there will be a color change on younger culms); usually, this buries the main rhizomes two–four inches. Water until soil is settled (tamping can damage rhizomes). Apply mulch to a depth of two–three inches.

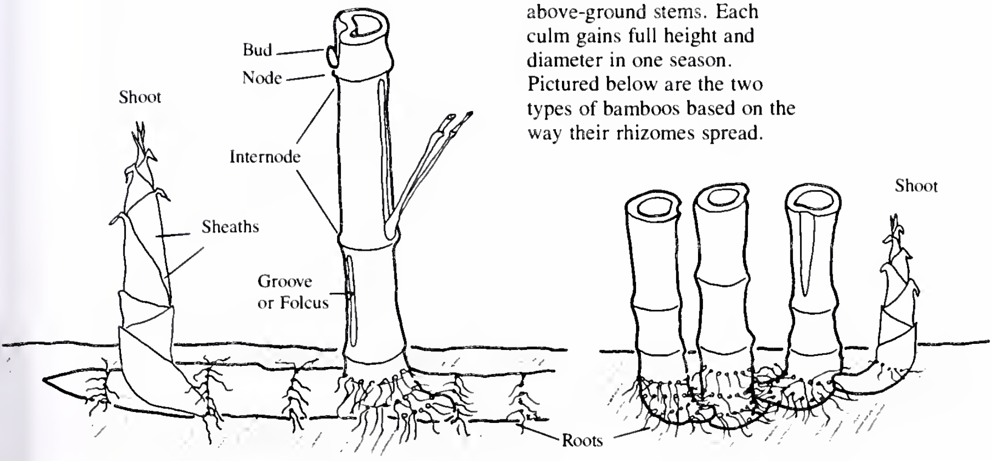
For the first season, watering is critical. The soil should never dry; a thorough one inch of water every 5–10 days minimum is needed. Once established, bamboos are quite tough. Little care is needed except yearly fertilization and mulching just before shoots appear and irrigation if climate dictates. Dead culms should be removed or they choke the clump. Pruning all three-year-old culms gives maximum regrowth for most species while taking only four–five year ones promotes fewer but larger culms.

Transplanting Bamboo: The commonest method of propagating bamboo of all species is by divisions transplanted in the spring. Divisions may be taken from the edge of a clump, or the whole clump dug up and split. The smallest division should include two culms (from two years' previous growth), connected by rhizomes and showing a strong new shoot-bud. Usually it is wise to take larger divisions, about a foot square. The fibrous roots may keep a division with dead or missing rhizomes alive for several seasons, but new shoots will not be reproduced.

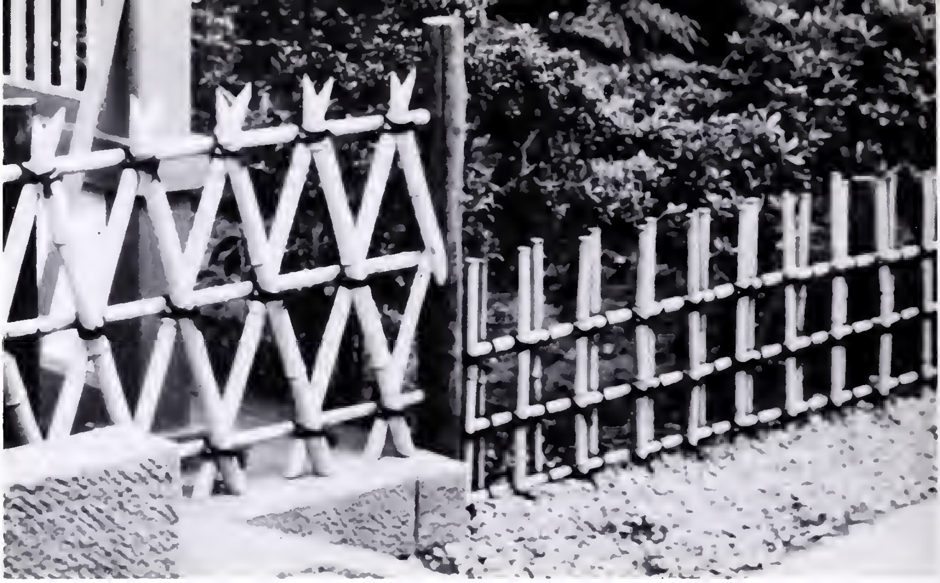
Bamboo transplants' roots and foliage are *very* vulnerable to drying. The transplanted culms will most likely die within one or two seasons, by which time there will be new culms to carry on. To slow transpiration when dividing, the old culms can be cut back. But opinions vary on whether this should be done or not. Cut-back culms are unsightly and the process deprives new shoots of shade and shelter which can be critical. Pruning a number of whole *branches* seems preferable; antitranspirants might also be justified. Painstaking moisture protection can allow division at any time *except* when new culms are extending rapidly.

All drawings courtesy of author

All bamboos grow from rhizomes, and from buds on these grow the culms (also called canes) which are jointed above-ground stems. Each culm gains full height and diameter in one season. Pictured below are the two types of bamboos based on the way their rhizomes spread.



Running species   Underground stems   clump-forming species


Brooklyn Botanic Garden

Bamboo is used as a construction material in almost all Japanese gardens. It is often used for fences tied elaborately where it intersects.

Physical Damage: Rhizomes lie near the surface. Cultivating tools, tamping during planting, and careless walking can damage them. Wind whipping older culms can kill or deform soft new shoots. Tying five or six culms together in a "tipi" will prevent snow damage and mulch will increase frost tolerance.

Pests & Diseases: There are few and are mostly confined to hot humid areas. Rust fungus causes leaf spots and if removing diseased leaves is not enough, fungicides may be used.

Scale insects are a common problem but only unsightly on California and Florida bamboos: they can be removed with soap or oil spray. Mealybug can be removed by water pressure. Ants usually 'herd' these insects, and may require control.

Squirrels and rabbits can be serious pests when their populations are large and hungry, as they eat bamboo shoots. The hard culms are not palatable to these animals, so temporary protection of soft shoots is practicable.

Lawn chemicals near bamboos should be watched with great care since as grasses, bamboos react differently to poisons than broad-leaf plants. Bamboos are vigorous enough to out-compete most weeds anyhow.

Flowering: This remains a vexed question for bamboo growers. Many species flower on a few culms each year and even those that flower and die will probably grow back from rhizomes or from seed. If prize specimens start to flower, some gardeners try heavy watering, large doses of nitrogen fertilizer and pruning the flowering branches. This may or may not help and should only be tried if flowering is noticed.

Containment & Eradication: The most effective method of controlling invasive species is to put a solid curb around the planting. This should be 24–30 inches deep, extending an inch above soil. It can be made of concrete poured directly into a narrow trench, of sheet metal, thick plastic lining or other material so long as all joints are lapped, tightly joined and sealed. Escape is likely through any hole ¼ inch or larger!

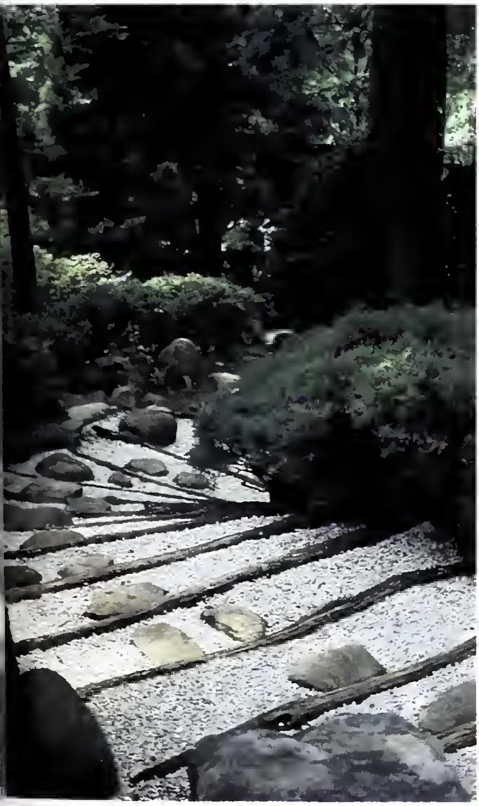
Mowing or hand removal of all unwanted new shoots will contain bamboo with barriers, but requires vigilance. Trenching (or for dwarf species slicing with a spade) all around the stand may be effective if done annually. Don't forget the neighbor's yard—gardener and bamboo alike can get a very bad name! Bamboo rhizomes are unlikely to damage walks or foundations as they usually change directions first. If bamboo must be completely removed, dig it out or cut it down; remove any new shoots by hand by mowing or plowing.

Far from being rooted out, however, bamboos are useful, magical plants which can add to any garden, Japanese or not.

ELEMENTS OF A JAPANESE GARDEN

Elizabeth Scholtz

The water basin at Ryoanji is shaped like an old Oriental coin, making it unusual. The ladle placed across the top invites the visitor to cleanse himself. Rocks, moss and plants complete the setting.


Claire Sawyers

Claire Sawyers

Stephen Morrell

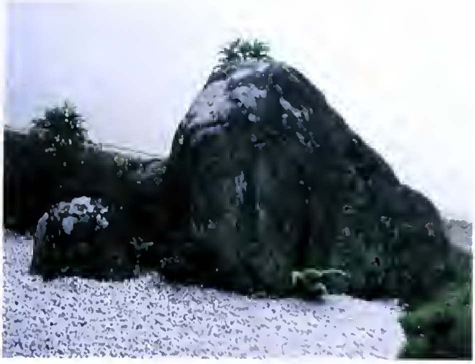
The teahouse at the Humes Stroll Garden is the center of this garden's design. It offers a retreat set in the midst of various shades of green. Here the accent is on the delicate pink of spring-flowering cherries.

The path at the Humes Stroll Garden leads down a natural slope to the pond at the base of the hill. Gravel and rocks mimic mountain streams and invite the visitor to pause.

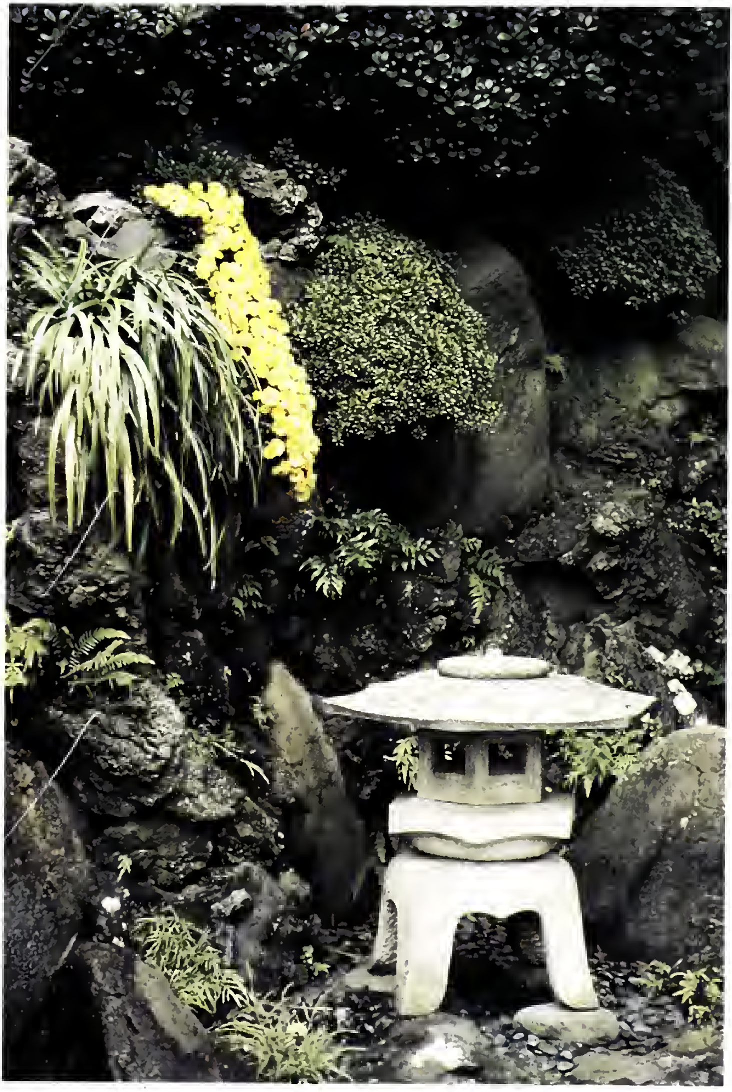
Brooklyn Botanic Garden's own Hill-and-Pond Garden changes with the seasons. Spring brings first the apricot flowering, then cherries and later azaleas. The torii is modeled after the famous camphorwood one in Miyajima, which stands in the sea. The word is casually interpreted as a "gateway to heaven."

E. Ortner

Elizabeth Scholtz

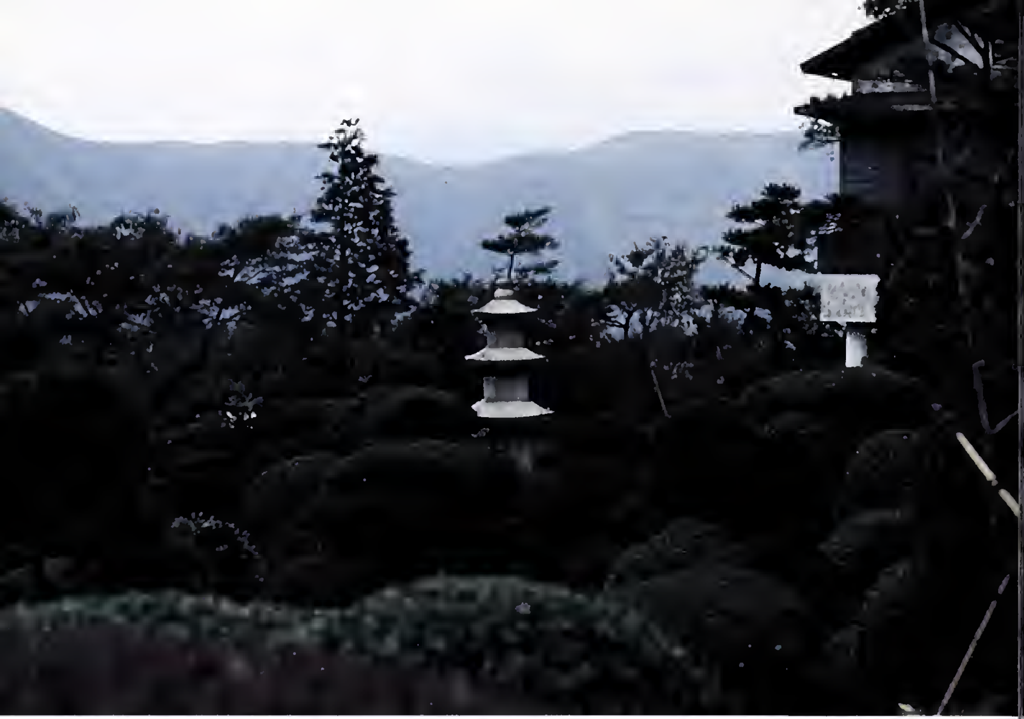


Daisen-in at the Daitokuji Temple, Kyoto. This composition resembles a black-and-white ink painting of a landscape. It was constructed in the 15th century.

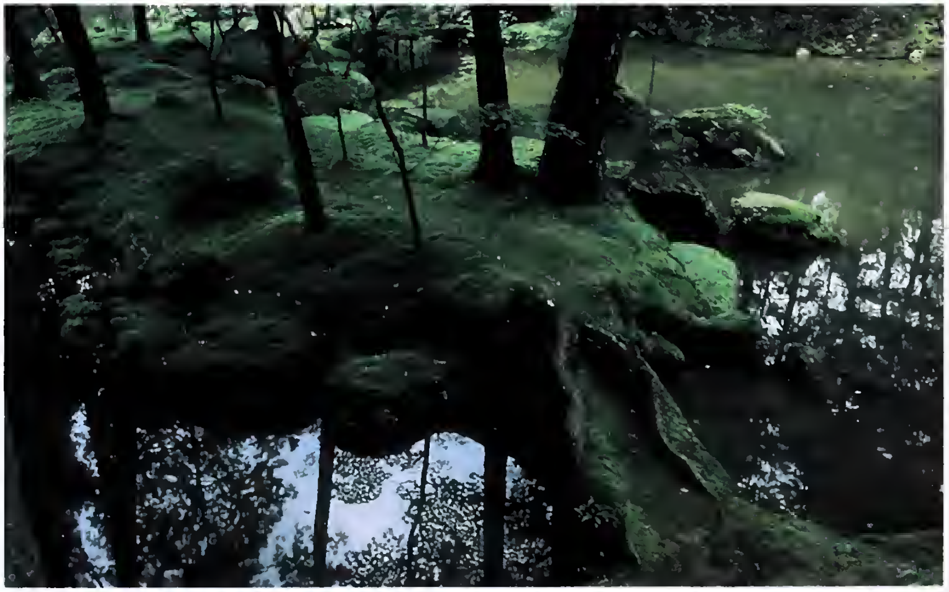


The Japanese hotels and inns often have gardens. On the left is a water basin with plumbing so that there is a constant flow of water from the bamboo spout. The photograph to the right contains a snow-viewing lantern with a lovely cascade of yellow chrysanthemums in the background.

Elizabeth Scholtz



A garden in Japan for a corporate retreat which relies upon borrowed scenery of the background mountains. The carefully sheared shapes of the shrubs in the foregound suggest cloud shapes and hills. Color is used with restraint.



Gnarled old roots are etched on a background of lush green moss while the trees are reflected in the surrounding water.

Special Purpose Bamboos

Hedges: Most bamboos can be used for hedges and windbreaks. *Bambusa glaucescens* (a.k.a. *B.multiplex*) is called Hedge Bamboo; for clipped hedges it and *Shibataea kumasaca* are two of the best. *Sasa tesselata*, *S. palmata*, and *Arundinaria anceps* (all strictly contained), *A. simonii*, *Semiarundinaria iastuosa*, *Pseudosasa japonica*, *Sinarundinaria nitida*, *Thamnocalamus spathaceus*, and smaller *Phyllostachys* such as *P. nigra* are also good choices.

For hedge use, choose a species whose mature height exceeds the desired hedge height by 25%. Plant closely (about one quarter the expected height). Running species must be contained in a trench, and their runners aligned with its length. Allow the planting to gain mature height (usually 3 years) before beginning to clip once or twice yearly. Thin older culms evenly and regularly.

Container Planting: The Japanese, rather than fight climate, make excellent use of indoor/outdoor container plants, changed seasonally. In addition to tender bamboos such as *Bambusa glaucescens*, *Arundinaria falconeri*, *A. aristata*, *A. hookeriana*, and *Sinobambusa tootsik*, several hardy species thrive in tubs, showing off their decorative culms. Among these are any *Chimonobambusa*, including the marbled *C. marmorea* and square-stemmed *C. quadrangularis*; *Phyllostachys aurea* with its swollen nodes, and *P. nigra*'s dark stems. *Pseudosasa japonica*, *Sinarundinaria nitida*, and *Thamnocalamus spathaceus* are also attractive.

Potted bamboos must have coarse, well-drained soil, and regular feeding and watering. Liquid fertilizer twice weekly is needed during shooting; the soil must neither dry nor be sodden; and humidity should be moderate, avoiding drafts. Bamboos like generous root space, but seem to regulate their own growth before becoming potbound; if repotting, root-prune at the base of the ball to avoid lifting in the pot. Night temperatures should be dropped to 45–50°F in winter for temperate species, which do not thrive in year-round heat; tropical species require minimum temperatures 10–20° degrees higher.

Canes: In an Oriental garden, bamboo timber is indispensable. It is simple to manage an ornamental planting to serve this second purpose. Some of the best species are *Arundinaria amabilis* (Tonkin cane), *A. anceps*, *A. simonii*, *Bambusa glaucescens*, *B. oldhamii*, *B. tulda*, *Phyllostachys bambusoides*, *P. meyeri*, *P. nigra*, *P. aurea*, *Pseudosasa japonica*, *Sinarundinaria nitida*, and *Chimonobambusa falcata*. Potassium and phosophorus fertilizer can increase strength.

The planting should be allowed to grow uncut for 3 years. For sustainable harvest, one year's growth must equal one year's cut; mark the new culms each year with paint. Harvest with a hacksaw when the culms start to turn yellowish tan. Cure in a dry, shady, ventilated place for 3–12 months; support to avoid warp, and turn periodically.

Properly cured, canes resist rot for 10 years or more. Lashing is best for joining them; pegs, nails, and bolts will work with pre-drilled holes. To split canes, use a sharp knife and even pressure from the *top*; a rod run through the membranes inside the nodes makes bamboo pipe. A node with one branch attached makes a water-scoop for the *tsukubai*.

Shoots: Western gardens are intimately connected with food, and a Japanese garden need not be a museum piece. Many ornamental bamboos provide that delicacy of Oriental cuisine, the edible shoot. *Phyllostachys dulcis*, *P. nidularia*, *P. mitis*, and *P. bambusoides* are among the sweetest; many others can be used if boiled in two waters.

To ensure sustained yield, the Japanese use this system, which also gives an annual harvest of canes: establish the planting for 3 years, or until mature-size culms are being produced. Mark *and count* the first set of full-size culms. Next Spring, LEAVE that number of shoots to grow into culms, marking them with a new color, and harvest all other shoots to eat. Repeat every year, and as each group of marked culms reaches 5 years of age, harvest them in Fall for canes.

For Further Information and Bamboo Sources Contact:

The American Bamboo Society
1101 San Leon Court
Solana Beach, CA. 92075 (714) 481-9869

Bridges are constructed in graceful curves to be reflected in the water. The viewing pavilion represents the home of the host and affords the best views of the garden. Flowering plants are used minimally as they are transitory. Preference is given to evergreen trees and shrubs in association with rocks and water.

THE JAPANESE GARDEN OF THE BROOKLYN BOTANIC GARDEN:

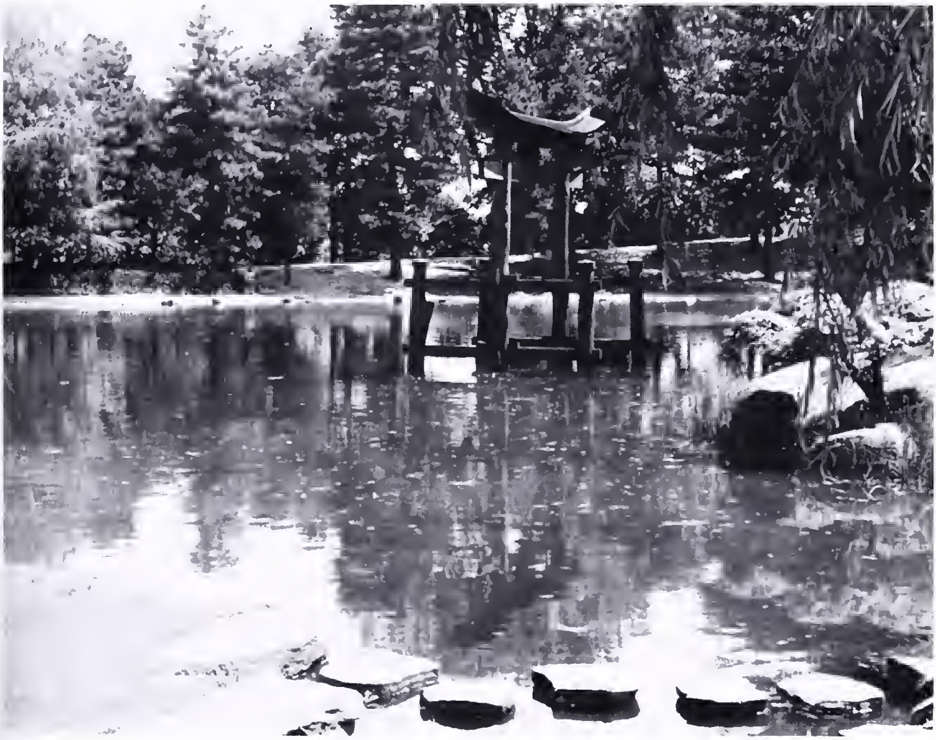
THIS GARDEN IN BROOKLYN is a traditional Japanese landscape garden, designed and constructed in 1914–1915 by Mr. Takeo Shiota. It was his ambition to make the most beautiful garden in the world. By 1915 he had designed and constructed eight gardens in the vicinity of New York, and his crowning achievement was the one in Brooklyn. All lovers of beauty are indebted to this talented artist who came from Japan in 1907 and lived in New York until his death in 1946.

This garden centers upon a small lake, the outlines of which describe the strokes of the Chinese character *shin*, meaning 'heart' or 'mind.' The lake is fed by a cascade of waterfalls. A small turtle-shaped island is reached by a Drum Bridge. A roofed Waiting-Pavilion faces the lake, and hanging out over the water is a modified Tea House with adjacent open pavilion.

In the largest section of the lake stands a *torii* or 'gateway to Heaven.' The Shrine on the hill beyond is dedicated to Inari, the Shinto God of Harvest.

There is a tall pedestal-type stone lantern near the waterfall and a low, broad-roofed 'snow-viewing' lantern on the island.

The principal plants of Japanese origin that are included in this garden are Japanese maples, flowering cherries, azaleas, barberry and flowering quince. Restrained use is made of Japanese irises in small clumps around the lake. Flowering plants are used with restraint. ❧



Both photos courtesy of Brooklyn Botanic Garden

A torii indicates the presence of a shrine nearby. The word is casually interpreted as a "gateway to heaven." This one stands in the pond of Brooklyn Botanic Garden's own Japanese Hill-and-Pond Garden. Carefully placed stepping stones lead the visitor across the water.

Courtesy of Missouri Botanical Garden

THE CHALLENGE OF BUILDING A JAPANESE GARDEN IN THE UNITED STATES

Koichi Kawana

IN THE PERIOD following the end of World War II, many "Japanese gardens" were built in the United States. However, most of them tended to be merely an assemblage of typically Japanese features derived from books on Japanese gardens or copied from photographs of features in such gardens.

No garden should be constructed in a foreign environment without being closely related to its surroundings. The degree of authenticity of a Japanese garden depends, for the most part, on the creativity and the statement of the designer, as the basic principles of such a garden are assimilated to the unique local environment. This is a major challenge since the garden must be designed with local climatic and topographical limitations in mind.

According to the *Sakuteiki*, the earliest known Japanese garden manual compiled in the 11th century, a particular topography suggests or demands a certain kind of garden design and the designer should respond to it. The subordination of man relative to nature is a time-honored design concept in Japan.

The 14½-acre Japanese Garden at Missouri Botanical Garden, Seiwa-en, was designed by the author. The pond, islands, streams and waterfalls were constructed in what was a former, little-used part of the Garden. Rocks were carefully placed, dry gardens created, pines selected for their potential to be trained and bridges built. As this garden has matured it blends with the surroundings and careful maintenance preserves it. This is an early photograph during construction.

Fortunately, I have had the opportunity to design Japanese gardens throughout the United States including ones in St. Louis, Chicago, Denver and Los Angeles. Most of these cities experience extreme seasonal variations in temperature and many trees and plants commonly used in gardens in Japan will not survive. For this reason, I worked closely with staff members of those gardens to search for plants which grow well in these climates and, at the same time, possess the shape and texture to recommend their use as substitutes for plants found in Japan.

Japanese black pines (*Pinus thunbergiana*) are featured trees in gardens in Japan and in that country, beautifully shaped pines have been readily available. But climatic conditions in some of the cities of the United States make it necessary to substitute Scotch, Austrian (*P. sylvestris, P. nigra*) or other pines. Bushy, untrained pines with the potential for training must be found. They must be trained to take on beautiful forms. Imagination, skill and patience are required. Difficulties are found with other plants which are typical for gardens in Japan such as camellias, azaleas, threadleaf Japanese maples, bamboo, and moss, and substitutes must often be found for them as well.

The search for and selection of rocks and their proper arrangement poses another major challenge for the garden builder. The arranged rocks are the skeleton of the Japanese garden. In Japan, the designer can select stones ideal in shape and color at a stoneyard even though the cost may be substantial, but in the U.S. finding appropriate rocks and arranging for their transportation is difficult. It is often necessary to utilize poorly shaped stones to develop a stone arrangement.

Since the stone arrangement is the major structure in a Japanese garden, the designer in Japan may spend hours to set one stone or to change an arrangement found to be inappropriate. In the U.S. the contractor, conscious of the cost of time and labor, depends upon the designer to make a swift decision as to which is the top or bottom and front or back of the stone as it is lifted by a crane and hangs in the air. Once it is positioned, it is difficult to change it. Thus, in the United States, those involved in stone arrangements need additional skill and training to achieve the desired goals.

For a Western type landscape the designer creates a design and provides the landscape contractor with a blueprint. The latter installs trees and stones according to the drawings and specifications furnished. In building a Japanese garden, however, the blueprint serves only as a general guide and is useless unless the garden is constructed by the designer himself or by a garden technician who is familiar with Japanese installations. Otherwise the design may be excellent but the end product may be a disaster.

The arrangement of stones and feature trees can be compared to the creation of a sculpture especially when form, size and line movement are considered. In Japan, the designer or architect will either personally supervise the installation or delegate it to the *Niwashi* or garden technicians who specialize in stone arrangements and plantings in such gardens. In the United States, the designer of a Japanese garden needs to be an installer and should also possess expertise on the trimming and training of feature trees.

Another challenge to the builder of Japanese gardens in the U.S. is the difficulty encountered in meeting the requirements posed by local building codes. Such codes affect the building of the foundations of arbors and other garden structures, the materials and construction of teahouses and bridges and the treatment of the edges of lakes. These structures must be authentic in appearance, but many of the structural elements require the closest collaboration with engineers in order to pass the required government inspections.

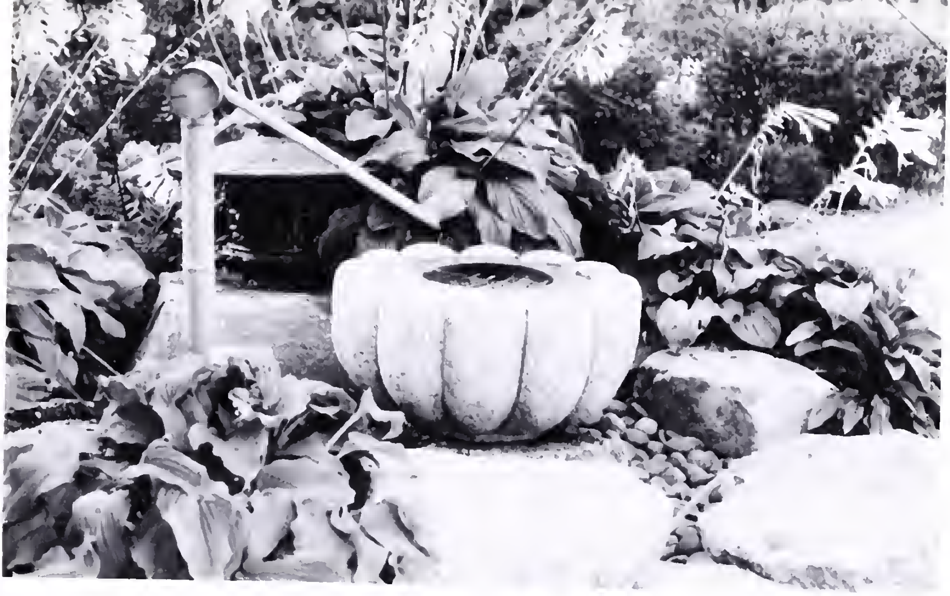
The use of building materials such as bamboo, cedar bark and black rope poses another challenge. In Japan, materials of this type are replaced every several years. In the United States their use would be limited, durable substitutes should be found or, ideally, proper maintenance and cyclic replacement should be insured.

The element of time plays an important role in a Japanese garden. After Zen Buddhism became popular in Japan during the 13th to the 15th centuries, Zen esthetics such as *wabi, sabi, shibui, yugen* and *koko* which can be translated as "profound and refined elegance with the quality of aged maturity," became essential values for a Japanese garden. Such values can be achieved only by the passage of time accompanied by caring maintenance. For this reason the designing and building of a Japanese garden are only the beginning. To achieve maximum potential, the garden will require time and meticulous care. In this respect I have been called on to instruct the garden staff in maintenance procedures during the construction phase of many gardens and to make periodic visits to those gardens previously built in order to oversee their maintenance and development efforts.

In conclusion, it is ironic but, due to Westernization and funding problems, many of the difficulties which have faced those developing Japanese gardens in the U.S. now beset Japanese gardens in Japan. ☙

Sansho-En, Chicago Botanic Garden, is a promenade style which invites the visitor to stroll the paths of this 17-acre garden. It was completed in 1982 and was designed by the author. Here raked gravel gives the suggestion of ripples in the water.

Fog shrouds one of the islands and the pond reflects the trained pines. As seasons change the accents move from pink azaleas to cherries and plum trees. Green is the predominant summer color while fall is announced with the blazing foliage of maples, euonymus and viburnums.



A water basin with hidden plumbing that provides a flow of water through the bamboo "pipe" supplies moisture for mosses and hostas.
Stones are carefully placed and a *yukimi* lantern completes the scene.
The background hedge is composed of arborvitae.

All photos courtesy of Kris Jarantowski

PINE BREEZE VILLA (Shōfū-sō) THE JAPANESE HOUSE AND GARDEN FAIRMOUNT PARK, PHILADELPHIA, PA

Mary I. Watanabe

AT PINE BREEZE VILLA, a 16th to 17th century-style Japanese house and garden form a serene yet elegant entity, in a location which is both harmonious and historic. Aesthetically, the villa benefits from the slopes and expanses, the magnificent large old trees and other plantings of the surrounding areas of Fairmount Park. Historically, the site is important in the development of Japanese architecture and landscape design in America. This section of Fairmount Park has had Japanese landscaping and a Japanese structure almost continuously since the last quarter of the 19th century. During the 1876 Centennial Exposition in Philadelphia, the Japanese bazaar was across the street from the current site. The garden, associated with the bazaar, was probably the first Japanese garden in America. From 1905 until a fire in 1955, a 300-year old Japanese temple gate originally exhibited at the 1904 Louisiana Purchase Exposition in St. Louis stood there. Shōfū-sō has been at the site since 1958.

The *shoin-zukuri* (deck-style construction) house, with an adjoining teahouse for the formal tea ceremony, was designed by the contemporary Japanese architect, Junzō Yoshimura. It was exhibited at the Museum of Modern Art, New York, in 1954–55, and subsequently given to the City of Philadelphia. The garden, appropriate to the house and terrain, was designed by Tansai Sano.

Under the direction of architect George Shimamoto, the house underwent extensive repairs in 1976, made possible by a Bicentennial

The southeastern view from Pine Breeze Villa provides many of the elements of a 16th–17th century garden of a private Japanese residence. The island, reached by a low bridge, features a shaped pine (*Pinus sylvestris*).

gift from the Japanese government and people. Later, rejuvenation of the garden began, supervised by landscape architect Masao Kinoshita. Although repairs, replacements and additions of plants, and other changes have occurred, Sano's design for the traditional landscape garden remains: the intimate relationship between house and garden is evident; the layout and landscaping create, in a limited space, the effects of depth and scale; the small hills, rocks, water and trees recall the mountains, streams, lakes and forests of Japan; and the garden integrates the house with its Fairmount Park setting.

The villa occupies about one acre, almost half of which is the pond of the main garden. A solid, white plaster wall with dark, Japanese tile coping, encloses the northern and western sides of the compound. The other boundaries behind the pond are open, permitting views which borrow from the outside scenery and landscaping of Fairmount Park.

The main entry to the villa is through a pair of wooden gates set in the northern section of the wall. There is also a special entrance on the south side for the teahouse and its garden. The grounds are landscaped on all sides of the house, but is the southeastern view from the house that provides many of the elements of a 16th–17th century garden of a private residence in Japan: a large pond with an island; a stream coming from the rear of the house; mounds constructed to resemble hills; a waterfall; and carefully placed large rocks. The pond at Shōfū-sō contains *koi* (carp); the island, reached by a low wooden bridge, features a shaped pine (*Pinus sylvestris*); stone lanterns and stone water basins are placed at appropriate spots of the villa.

At Shōfū-sō, azaleas of many colors, rhododendrons, flowering cherries and other fruit trees, magnolias and tree peonies are the major blooming plants. Maples, pines, cryptomeria, chamaecyparis, bamboo, andromeda, yews, a weeping mulberry, a corkscrew willow, as well as holly, barberry, bayberry, euonymus, are other plants at the villa serve to provide a predominantly green garden. Except for grass in the back garden and on the mounds, the major groundcover is pachysandra.

The garden of Pine Breeze Villa is one to be enjoyed from the verandas and the rooms, but stepping stones permit strolling through various sections of the garden. ☘

Both photos courtesy of Mary Watanabe

The house underwent extensive repairs in 1976 made possible by a Bicentennial gift from the Japanese government and people. It is deck-style construction (*shoin-zukuri*) which integrates the interior with the outdoor garden spaces.

THE JAPANESE GARDEN AT THE DAWES ARBORETUM NEWARK, OHIO

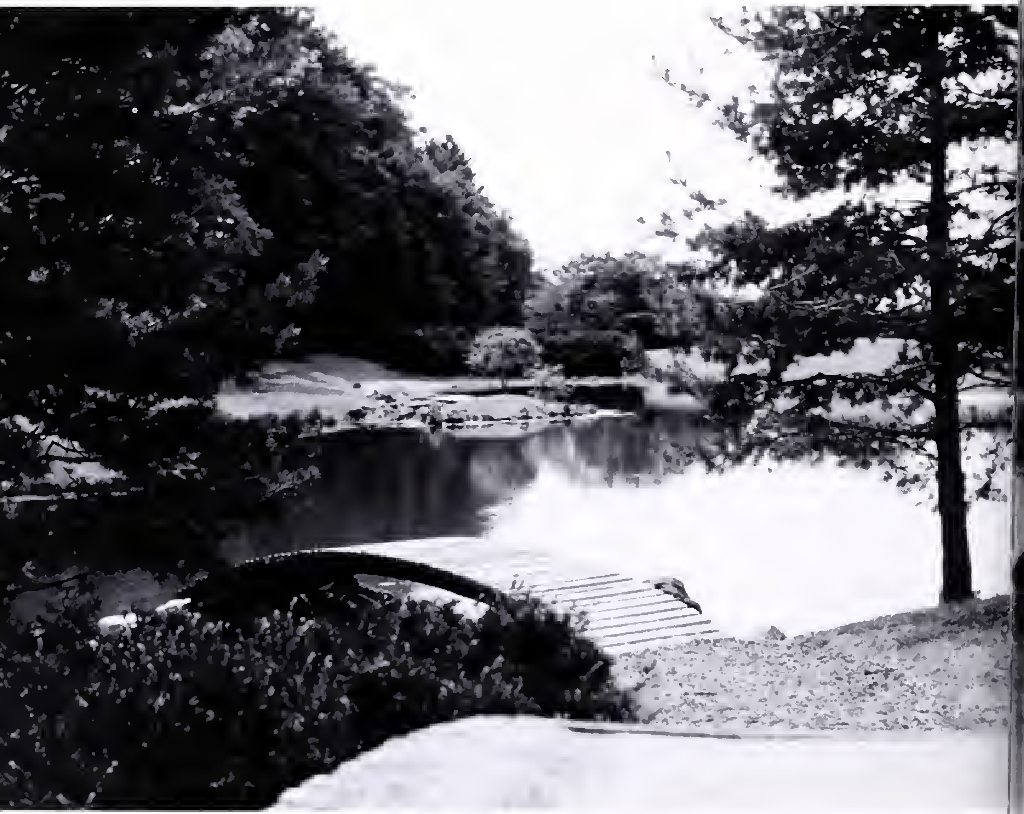
Alan D. Cook

SOME VISITORS to the Japanese Garden at the Dawes Arboretum are disappointed because of "plainness." Others are delighted, for the same reason. They see a garden designed to instill tranquility yet blend smoothly with the open fields and rolling hills of central Ohio.

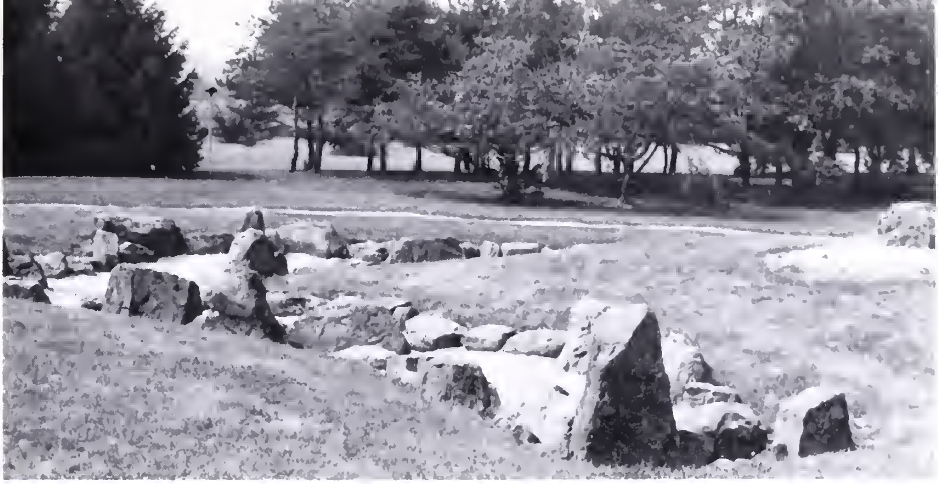
The garden was designed and constructed by Makoto Nakamura, Lecturer in Landscape Architecture, University of Kyoto, Japan, during a cultural exchange visit in 1964.

Mr. Nakamura conceived the garden, "as an experiment in the exchange of two cultures—American and Japanese." He points out that it can hardly be called an "authentic" Japanese garden because it is constructed of American materials by local craftsmen to suit American conditions. On the other hand it presents the basic idea of Japanese design which is to create landscapes suggested by natural scenery. In Mr. Nakamura's words, "in the Japanese garden

Both photos courtesy of Alan Cook



The upper part of this garden is dominated by the water feature with connecting bridges, shorelines and islands. The path leads to a Meditation House where the visitor may rest and contemplate the vistas.



The lower level of the garden is dominated by a boulder-lined dry stream.
This composition suggests mountains and a rushing torrent of water.
The plantings provide a windbreak and a background for flowering cherries.

these are abstracted from real landscapes, but are easily recognizable."

This garden is composed of two parts. One enters a lower-level where there are several earth mounds capped by rugged boulders, and a "dry run" bordered with rocks. Mr. Nakamura writes, "the motif here is a forceful landscape of America." This composition suggests craggy mountains and a boulder-lined torrent. The plantings here consist chiefly of a windbreak of pine and spruce which makes a background for flowering cherries.

Next, one comes into the upper or main portion of the garden which is a water-dominated landscape with several typical Japanese garden elements: pebble beach, shoreline rock and boulder compositions, islands with connecting bridges, and a natural spring. The path leads to these major points of interest and conducts the visitor to the Meditation House located in an ideal spot for resting and enjoying the garden.

Plantings in this area include several shrubs native to Japan and used in Japanese gardens such as the Japanese yew (*Taxus cuspidata*), kerria (*Kerria japonica*), flowering quince (*Chaenomeles speciosa*), Japanese maple (*Acer palmatum* varieties). The climate of The Dawes Arboretum is more severe than that of central and southern Japan where the most important gardens occur. Many substitutions of hardy American and European plants were made including rhododendrons (*Rhododendron catawbiense* and *R. carolinianum*), Scotch pine (*Pinus sylvestris*), dwarf Norway spruce (*Picea abies* varieties) flowering dogwood (*Cornus florida*), Canada hemlock (*Tsuga canadensis*).

In the Japanese garden one may miss the massed color from flower and shrub beds characteristic of American and European gardens. But its purpose is to create an atmosphere of calm serenity, encouraging one to stop for rest and for contemplation. It is a haven of peace, removed as far as possible from the confusion of the workaday world.

In judging the work of Mr. Nakamura one should bear in mind not only the fundamental ideal of this kind of garden, but also several peculiar circumstances not usually associated with garden building. First, the setting is among a grove of trees set out as forest test plots, and the lake is designed primarily as a flood control reservoir. Neither of these major elements relate to a Japanese garden, but both are incorporated successfully into the design. Second, the 400-some large boulders which form a conspicuous part of the decoration were gathered from all parts of Licking County, transported to the site and placed by crane. Third, the construction of the Meditation House and the bridges called for skilled craftsmanship in wood and foreign techniques, but here again Mr. Nakamura found local men could accomplish the purpose under his patient direction.

"Thus this garden was built through the experimental efforts of so many people, using mostly indigenous American materials," Mr. Nakamura writes. And he adds, "If the visitor, sitting quietly in the Meditation House feels a peculiar fantasy in the environment, then he will become another part of the experiment." ☘

SANSHO-EN
THE GARDEN OF THREE ISLANDS

Kris S. Jarantoski

CHICAGO BOTANIC GARDEN'S Sansho-En, is a promenade style garden, which invites visitors to meander along winding paths and slowly discover the beauty of its 17 acres. The unique garden plan featuring three islands was designed by Dr. Koichi Kawana and was dedicated in 1982.

The large northernmost island, Horaijima (Island of Everlasting Happiness), is a rolling, sparsely planted landscape inaccessible to visitors—to be viewed from a distance. On cold autumn mornings mist shrouds it. The middle island, Seifuto (Island of Clear, Pure, Breeze), contains a rustic arbor. Nearby water trickles into a basin next to an *oribe* lantern. All this is hidden behind a small pine forest in the *mie-gakure* or "seen and hidden" style. A boat landing (*funatsuki-ishi*) is composed of two large slabs of granite. Keiunto (Island of the Auspicious Cloud) is the southernmost, largest and

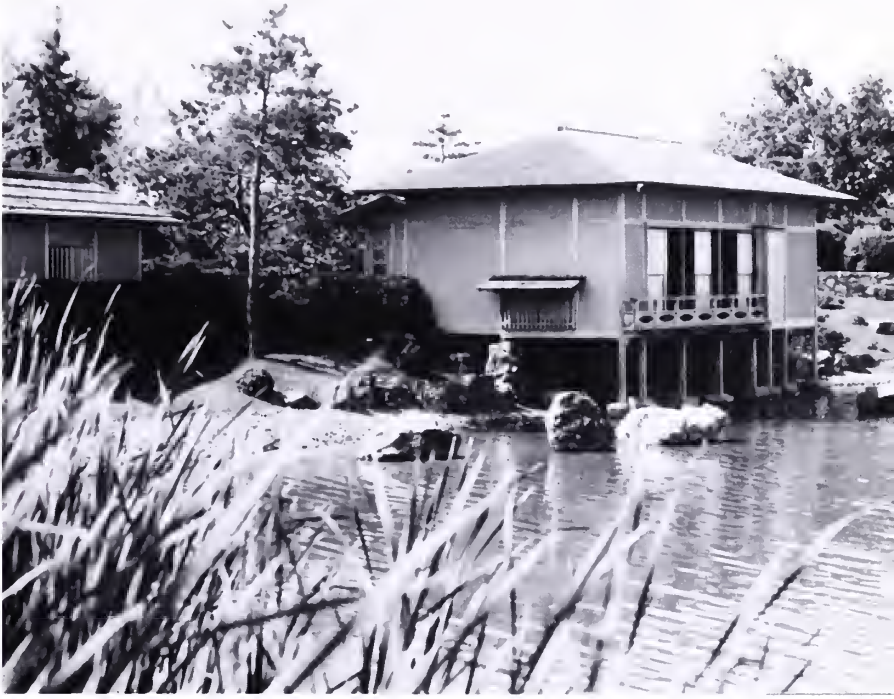
All photos courtesy of Chicago Botanic Garden

highest of the three islands. There, the umbrella arbor, offers visitors a chance to relax on porcelain stools of Chinese style. The adjacent dry garden contains bush clover, hydrangea and boxwood and is defined by a mixed hedge of holly, privet and flowering quince. The Shoin building, designed after the summer home of a Japanese feudal lord and nestled in an inlet on Keiunto, is the focal point of Sansho-En. The lush moss garden adjacent to it with water basin, *yukimi* lantern, and hostas, is surrounded by an arborvitae hedge.

Sansho-En's subtle, refined elegance is softly punctuated by seasonal changes. Rolling hills of pink azaleas, cherry and plum trees, forsythia, and crabapples announce the arrival of spring. Flowers of eulalia grass (*Miscanthus*) and bush clover (*Lespedeza*) along with ripening persimmons and the blazing foliage of maples, euonymus and viburnum foretell the coming of winter in the continuous rhythm of nature. Pines, yews and boxwood soften the Chicago winter and enhance the frequent snowfalls.

Sansho-En is a compilation of many styles of Japanese garden design which stirs the imagination, integrates people and nature, restores the heart and brings peace to the soul. ❧

The Shoin building, inspired by the famous Shoin building of Ritsurin Park in Shikoku, is cantilevered over the water. The boulders in the water are *yodomari-ishi* or nightmooring stones.



The arbor adjacent to the dry garden on Seifuto is called "House of Clear, Pure Breeze" named after the gentle winds that cool the interior. In keeping with the true spirit of such gardens, plants such as mugho pine, amur maple, crabapple and Scotch pine are used here.

SEIWA-EN
MISSOURI BOTANICAL GARDEN
Alan P. Godlewski

Seiwa-en, meaning "garden of pure, clear harmony and peace," occupies over 14 acres making it one of the largest Japanese gardens in North America. The garden is the result of a masterful design by Professor Koichi Kawana. The basic style of the garden is "strolling" garden (*chisen-kaiyushiki*). Gardens of this style have a lake as their main feature and were popular among the *daimyo*, or Japanese feudal lords during the 17th and 18th centuries. The other facet of their design is extensive lawn areas which relate an expansive feeling.

The 4½ acre lake in Seiwa-en is irregular in its configuration, which permits vistas from divergent locations around the perimeter. A series of panoramas are revealed including four islands. Tortoise Island and Crane Island are auspicious symbols of immortality and happiness, Paradise Island is a three-rock arrangement projecting from the water near Crane Island. This island celebrates happiness and immortality, and is the spiritual center of the garden.

The fourth island, called *Nakajima* or Middle Island, is accessible by two foot bridges. When *taikobashi* or drum bridge, is reflected in the lake's surface, it outlines a circle. The second bridge, a *dobashi* or earthen bridge, is a low bridge constructed over a timber framework edged in mondo grass. The Middle Island also houses the teahouse, a structure built in Japan and given by Missouri's sister state Nagano Prefecture.

Several styles of stone lanterns are also used in the garden including the snow-viewing lanterns, or *yukimi-doro*. Two are preserved from the Japanese Imperial Exhibit at the 1904 World's Fair and another is a gift of Suwa City, Japan, the sister city to St. Louis. Another lantern projects out over the water with a slender arching stone base.

Seiwa-en is composed of plantings both native to Japan and Missouri. The framework of the garden is large oaks, cypress and black tupelo. Other plants are Japanese black pine, Kwanzan cherry, Japanese maple, star magnolia, and Japanese holly. These plantings are subtle arrangements of texture and color which are highlighted by seasonal display: spring is announced with weeping cherries, peonies and azaleas; summer with Japanese iris and lotus; fall by the brilliant colors of the oak, hickory, black tupelo and chrysanthemums; and winter is delineated by snow held upon the branches of the trained trees and the snow-viewing lanterns. This Japanese garden is a garden for all seasons.

Both photos courtesy of Tony Carosella

The four-and-one-half acre lake is a large part of this garden. There are also other water features including two waterfalls, streams and water basins. There are also suggestions of water in the dry gardens with raked sand and stones arranged as islands. Several bridges, a teahouse and carefully selected plantings complement this garden designed by Koichi Kawana.

This garden is designed around the teahouse which offers a quiet retreat. Plants are mostly evergreens underplanted with ferns and moss.

THE JOHN P. HUMES JAPANESE STROLL GARDEN, MILL NECK, NY

Stephen A. Morrell

THIS "STROLL GARDEN" was created by a Japanese landscape designer and his wife in 1960–62. In 1983 it was donated to the North Shore Wildlife Sanctuary it adjoins.

In keeping with the Japanese reverence for nature, the garden harmoniously blends the contrived with the natural. Using the existing topography to suggest the garden design, the sloping and forest land was transformed into an idealized landscape of mountains, streams, and ocean. Gravel paths mimic mountain streams and form areas to pause. The path leads to the pond at the base of the hill. Using traditional design principles of a stroll garden, vistas are revealed sequentially.

The design centers around a teahouse which offers a quiet retreat. Its garden provides a tranquil atmosphere using mostly evergreen plants, ferns and moss.

Plants in the outer stroll garden are a blending of existing native flora with indigenous Japanese plants, and reflect the changes in season so revered by the Japanese. With early spring come the delicate hues of cherry blossoms, followed by azaleas. Early summer brings a display of Japanese iris. During autumn, both native and Japanese maples turn brilliant shades of red, orange and yellow. Winter snow highlights the outlines of trees and lantern tops and makes designs on fences. ✿

Photos courtesy of Stephen Morrell

Japanese revere the changing of seasons. A flowering cherry bears blossoms of delicate hues which even add color and texture as they fall to the ground.

LESSONS FOR AMERICANS TO LEARN FROM JAPANESE GARDEN DESIGNERS

Part I. William H. Frederick, Jr.

THE CURRENT TREND toward lifting elements of an authentic Japanese garden and placing them in our alien setting offends my sense of appropriateness. To create and appreciate a Japanese garden one must have grown up in Japan, known the famous Japanese landscapes that have inspired these gardens, been part of a religious tradition that is highly disciplined, contemplative and ascetic, and been part of a society where much communication is by symbol. Can you imagine the average American pausing to contemplate the view from each stepping stone in his garden? I can't. On the other hand, I'm always delighted when a client goes to Japan to study their gardens—there is much to be learned.

The Yen for Japanese Gardens

I've tried to figure out why Americans want Japanese gardens and have come up with two possible reasons:

1. There is the notion they are low maintenance both because inanimate materials such as rocks and sand are major elements and because plants are relatively unimportant to the composition. This is a misconception. Sand must be raked after every rain and kept free from leaves and litter, and plants are important. Moss, often a major element, requires time-consuming effort to get it to thrive. Shrubs must be trimmed to conform to previously established mounded shapes and sizes. Trees must be trained into a particular shape (one of several important styles) and kept in that form. Remember, those Japanese gardens one sees in photographs for the most part belong to either the Imperial Family which has the wherewithal to employ professional gardeners of the highest skills or religious orders whose members have an abundance of time and dedication.

2. There is a feeling of peacefulness and strength in the photographs of the better gardens. (Not all Japanese gardens are great works of art.) This has an understandable appeal to Americans leading pressured and harassed lives. To me, if this is what is wanted from the garden, one should analyze how to produce these sensations in a manner that is appropriate for our times in our locale.

I'm also not convinced that "peacefulness" is the total answer to the modern American's needs, at least not the majority. Strong design as a framework is essential and in the case of the majority, this should be fleshed out with exuberance rather than asceticism.

Important Lessons

The Japanese have probably spent more time than any other nationality thinking about and developing a gardening tradition. Some of the important things to be learned from them are:

1. THE ARCHITECTURE AND THE LANDSCAPE ARCHITECTURE ARE DESIGNED AS A UNIFIED WHOLE. Every important room of the palace, temple or house is intimately associated with the garden.

2. THE PERSONALITY OF THE SITE AND COMMUNITY HAS A STRONG INFLUENCE ON THE TOTAL DESIGN INCLUDING THE SITING OF THE ARCHITECTURE, THE DEVELOPMENT OF GARDEN EXPERIENCES, AND THE TRADITIONAL "BORROWING OF SCENERY." Much of our own site development involves insensitive destruction of trees, rocks, interesting contours on the premise that it is more economic to "clear and level" with "new planting" to follow.

3. AESTHETICS ARE A PRIME CONSIDERATION IN THE PLAN FOR THE ARCHITEC-

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Editor's Note:

Armistead Browning and William Frederick traveled together and studied Japanese gardens in the Kyoto area for two weeks in 1981. Because of their similar exposure to Japanese gardens but their different landscape design philosophies, I posed this question to each as practicing landscape designers in America: ". . . What can we learn from Japanese gardens"?

Both have several answers to that question.

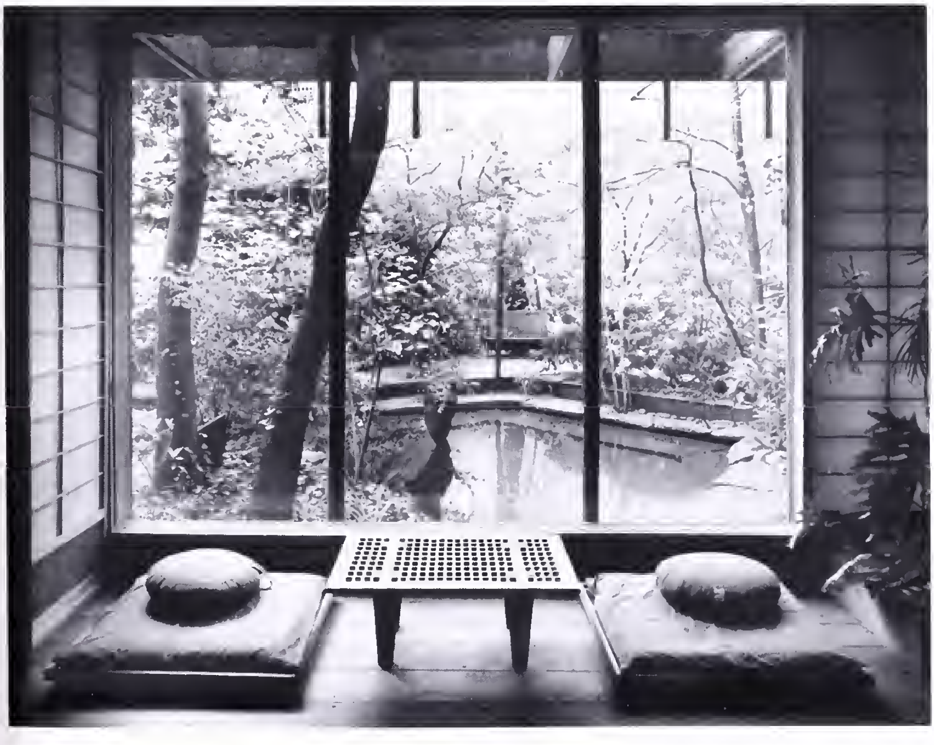
TURE AND LANDSCAPE. This is accomplished by:

- blocking out distracting views
- creating the feeling of more space than there really is by manipulating scale
- limiting the number of materials involved
- making certain open spaces (water, sand, lawn, pebbles, ground cover) have strong design forms
- reducing the complexity of the design to minimal abstractions (Reductivism)
- displaying a sensitivity to "occult balance"

Occult balance is another name for harmonious asymmetry (as opposed to bilateral symmetry). An understanding of occult balance in particular has important application in providing strength to the informal designs which often seem most appropriate to our contemporary life style. Such an understanding is not a mysterious gift of the talented few but simply a matter of training one's eye. Walter Beck (the creator of the American "Chinese Cup Garden" at Innisfree) engaged his guests in an after dinner diversion to sharpen their perception of occult balance. Three objects (such as three pebbles or a salt shaker, ashtray, and cigarette box) were placed on a coffee table. Each guest, in turn, arranged them in a manner which brought them into a state of repose with each other (from his or her viewpoint). The remaining guests then expressed their feelings of gratification or dissatisfaction and were expected to explain why. We all do this more or less unconsciously as we react to composition in painting and sculpture, choreography in ballet, and the massing of forms in contemporary architecture.

4. FINALLY, THE JAPANESE "STROLL GARDEN" WITH A CLEARLY DEFINED CIRCULATORY PATH ILLUSTRATES HOW TO LEAD ONE THROUGH A SERIES OF GARDEN EXPERIENCES AND MAKE MAXIMUM USE OF THE SPACE AVAILABLE. In some of the best English gardens, such as Hidcote and Sissinghurst, one is "directed" through a sequence of garden

American designer James Rose adheres to the Japanese principle of integrating interior and exterior space. This photograph is from the catalog *Built Landscapes*, Brattleboro (VT) Museum and Art Center.



Thomas Church's designs start with the functional needs of his clients and the character of the site, just as in the best Japanese gardens. Careful reductivism produces strong designs.

rooms providing separate and distinct experiences with sculpture, water and color and textural changes. Even in suburban America we are not without the experience of "walking around the yard" after supper. Because much of contemporary American garden design starts with a functional basis (car arrival area, entrance garden, outdoor living area, swimming pool garden, kitchen garden), we have the opportunity for a series of distinctly different, refreshing experiences and the Japanese tradition of the stroll garden has much to teach us about unifying these parts into a strong whole.

To see positive examples of these teachings in contemporary gardens:

- Look at the work of Ed Bye for indoor/outdoor relationships and reductivism applied to elements in the natural landscape producing moods of peacefulness and strength.[1,2]
- Look at James Rose's house-garden relationships where the house becomes a series of garden pavilions and the merging of indoors and outdoors is nearly imperceptible.[1,3]
- Look at Thomas Church's gardens where the personality of the site and the owners is the design basis and reductivism and strong design forms are paramount.[4]
- Study the relationship of Spirit Path and the highly color-charged flower garden in Beatrix Ferrand's garden created in Seal Harbor for the Rockefeller Family. This is a Stroll Garden successfully linking the extremes of spirituality and exuberance.[1]
- Study photographs of contemporary South

[1] *Built Landscapes, Gardens in the Northeast*, (Catalog of a traveling exhibition produced by Brattleboro Museum and Art Center); 1984.

[2] Bye, A.E., *Art Into Landscape, Landscape Into Art*, PDA Publishers, Mesa, AZ, 1983.

[3] Rose, James C., *Creative Gardens*, Reinhold Publishing, New York, 1958.

[4] Church, Thomas, Grace Hall, and Michael Laurie, *Gardens are for People*, (Second Ed.), McGraw-Hill, New York, 1983.

[5] Bardi, P.M., *The Tropical Gardens of Burle-Marx*, Reinhold Publishing, New York, 1964.

Carolyn Caddes

Here is an example of reductivism applied to elements in the natural American landscape. The photograph is by landscape architect A. E. Bye from the catalog *Built Landscapes*, Brattleboro (VT) Museum and Art Center.

American gardens by Roberto Burle Marx where design strength is achieved through a reductivism expressed in abstract color and textural forms related in sophisticated occult balance and where the "stroll" is through a three-dimensional piece of sculptured garden.[5,6,7]

- Visit the Abby Aldrich Rockefeller Sculpture Garden at the Museum of Modern Art in New York, designed by Phillip Johnson. This Stroll Garden can hold large numbers of people and works of art. In its most recent form there is a strong indoor/outdoor relationship to the galleries themselves and, as in its original conception, there is a finely tuned occult balance in each of its several areas; a fine tuning of scale which gives the individual the feeling of being in a residential setting; and strong and economical linkage of all the parts.[8]

Conclusion

I make the plea that we study the principles developed by Japanese garden designers over the years; that we apply these principles to developing a kind of garden design that not only responds to our own culture, but to our specific house sites and personalities. The tempo of our daily lives and the insecurities of our world situation call for strong medicine in our garden design and I feel this can best be accomplished by a variety of experiences, some of exuberance, within the same garden. This can only work on a framework of design strength about which we have much to learn from our friends in Japan.

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[6] Carter, Allen, "Gardens: The Hidden Valley," *ARCHITECTURAL DIGEST*, March, 1980, pp. 114–119.

[7] Gregory, Frederick L. "Roberto Burle-Marx: The Brazilian Extravaganza," *LANDSCAPE ARCHITECTURE*, May 1981, pp. 346–357.

[8] Kassler, Elizabeth B., *Modern Gardens and the Landscape*, The Museum of Modern Art, New York, 1964, pp. 36, 48–49, 53, 62–63, 66–67.

[9] Ibid. pp. 58–59.

Part II. Armistead Browning, Jr.

It isn't an exaggeration to say that Americans are obsessed with Japanese gardens. Hardly a month passes without another magnificent book on Japanese gardens appearing in the book stores. Articles on Japanese gardens are appearing with increasing frequency in magazines. The first Brooklyn Botanic Garden handbook on Japanese gardens went through six printings from 1961 to 1979.

And, we build them. Sadly, of course, none of them really look right. It is both a harsh truth and perhaps the most profound lesson conveyed to us by Japanese gardens that the only place they work really well is in Japan. Wedded to their environment, they are both an expression of one of the most powerful cultural traditions the world has ever seen and a distillation of a spectacular landscape at once dramatic and delicate. The overwhelming differences between American and Japanese culture and landscape, as well as differences in the way gardens are made and maintained, make it almost inevitable that a Japanese garden in this country will appear forced or out of place.

The few Japanese style gardens that do succeed are either didactic or exceptional, independent feats. The former do not pretend to be anything other than a display of Japanese art principles for educational or museum purposes. They express the intangibles of Japanese landscape design while using elements of the U.S. landscape — an almost impossible job. The latter are the rare products of an individual's art and building process so brilliant that the culture and landscape of Japan are evoked along with the actual garden — an even more impossible task.

But we can learn from Japanese gardens, and there is a delicious irony in all of this: Japanese gardens evolve from a culture and landscape alien to ours, but they teach us truths that apply to our own Western tradition of gardening. We *can* become better garden designers and garden makers by understanding principles and techniques used universally in the creation of Japanese gardens.

There is another point to make about the great appeal Japanese gardens have for us. Despite the cultural chasm between west and east, something in Japanese gardens bridges the gap. The strong spiritual and philosophic messages conveyed by Japanese gardens somehow fill a void existing within our own culture.

The Japanese Garden

Store the whole world in a grain of millet.
(Zen Haiku)

There is one misconception about Japanese landscapes to bury forever. Japanese gardens are not miniature landscapes. Miniature implies merely a smaller version of something, as a doll house is a smaller version of a real house.

The most significant idea that should be mastered is the Buddhist idea that the whole of the universe is contained even in its smallest part, as the haiku above suggests. This principle is a guiding beacon in Oriental philosophy and creative process. Consequently a Japanese garden, in effect, encompasses all of nature. It acts as a summation of nature — of its parts, of its binding energies — not a reduction of it.

The concept of worlds within worlds is directly applicable to garden making especially in reference to a new garden concept — the so-called ecological garden, born of the environmental movement in the United States. Among other things, the new ecologic garden emphasizes or brings into the garden elements of the natural world such as rock outcrops, wetlands, dead trees, animal and bird habitats, not simply for decoration but as expressions of natural process. Ecologic gardening is an affirmation, a celebration of the processes of nature and is based on an understanding of natural processes and of the relationships between the component parts of nature: water, soil, decay, animals, weeds, seasons, moon and rain. Events and items in the ecologic garden act then as a summation of the natural world and the forces that hold it together, in very much the same manner as they do in a Japanese garden. Accordingly, an American garden maker in the new ecologic garden tradition might base the garden around an existing swamp (water), an outcrop of schist (rock), or a thicket of sassafras (plants). In the design process, the designer adds or subtracts elements until the garden is complete as a distillation or summary of nature set within its originating landscape context. In this way, the ecologic garden parallels the manner in which Katsura or Ryoanji act as summaries of landscapes. The manner of their creation and appearance of the products are different, but the principle behind them is the same. Both Japanese gardens and ecologic gardens respect the natural world.

All photos courtesy of Armstead Browning, Jr.

Often the plant palette of a great Japanese garden can be described as a green tapestry. Blooming plants are few. The effect is one of peace and harmony essential to spiritual refreshment.

Mass and Space

At the most basic level, landscape design is the creation of space using framing and enclosing elements such as plants, landforms, fences, ground plane and sky. Space is framed from all sides and from top and bottom and is enlivened by focal points and accents within the spaces and by views reaching out over the landscape and visually connecting other spaces. Movement through the spaces is created by the designer with paths and quickened by accents or views along the route. Although all the elements of the landscape can be utilized in the development of space (rocks, water, soil, landform), plants are of particular significance for obvious reasons of beauty and interest.

It is easy enough to outline one designer's skeleton version of the landscape design process as I have done here and even to build spaces in the landscape. What is much harder to do—and this is the measure of success in landscaping design—is to infuse those spaces with the mysterious ingredients that provoke an emotional response.

The Japanese garden often represents exceptional achievement in the development of mass/space relationships, which act as a powerful carrier of mood and feeling. The *means* by which this is done serves as an instructive, forceful example to garden makers in this country. Consider the first view the visitor gets of Sento Gosho, an Imperial villa garden, initially built in the early 1600s (p. 63). The relationship between the placid, calm ground plane of the pond and the tumbling, turbulent enclosing masses of vegetation presses in upon the viewer, yet is held at bay by that polished mirror or repose. The visitor feels the power and mood of the place, caused specifically by the way the enclosing and framing elements of plant mass are built up and articulated. The rhythms and heavy masses of the enclosing plants are relieved by the pine tree acting as an accent, leaning in the direction of a lovely grassy clearing, itself framed by dense vegetation and by the pond surface. And finally, there is an absolute economy of means utilized in this composition: a pond, clusters of rocks used as accents, a leaning pine tree, a grassy patch, and masses of green vegetation.

Many Western observers regard pruning, shaping and supporting techniques used by Japanese gardeners as excessive, manipulative and distorting. However, from the Japanese viewpoint the process comes from understanding the tree.

Sento Gosho, an Imperial villa garden, illustrates the relationship between the calm pond and the enclosing masses of vegetation. The visitor feels the power and mood. There is an economy of means used in this garden.

The Idea of Journey

It has often been pointed out that one of the major differences between Western gardens (particularly French) and Japanese gardens is that in the Western garden everything is visible—there are no secrets. Whereas in the Japanese garden, although the route is clear, a part of the garden always remains hidden. There are secrets and mysteries which lurk just behind the visible: the garden viewer is invited to embark upon a journey of discovery. The theme of the journey has to do with the Japanese philosophic imperative, that of setting up gardens as vehicles to guide humans into an understanding of their oneness with nature, and so to the ultimate goal of harmony, peace and fulfillment. The Western garden designer can appreciate the procedures used in setting up the journey in a Japanese garden purely from a design point of view and as an instructive model to stimulate his thinking in the building of his own garden.

To the American garden designer, the specific techniques used by Japanese designers to create journey may not always work in this country. What is important is the use of Japanese gardens as conceptual models for developing the *idea* of journey in Western gardens, using Western procedures and techniques. Imagine how the short trip from garage to front door could refresh the tortured breadwinner if the traditional concrete sidewalk to the front door was a progression as a garden of discovery.

The Role of Plants

One flower opens, spring everywhere.
(Zen Haiku)

Many Western observers regard the pruning, shaping and supporting techniques used by Japanese gardeners as excessive, manipulative, and distorting. From the Japanese gardener's viewpoint, however, the shaping process comes from an understanding of the tree so that its essence is revealed. In effect, the gardener takes away from the plant that which is superfluous so its final form reveals its inner being.

There is much that the Western gardener can learn from this. Not Japanese pruning, shaping and support techniques, of course—that is the product of 2,000 years of evolution in a different cultural tradition. But doesn't a better garden often result when attributes of plants other than bloom, color and the purely ornamental qualities are explored? Attributes such as shape, bark, winter interest, age, relationship to animals and birds and variation in form.

The last great lesson out of the Japanese tradition with plants has to do with simplicity and economy of means. Often the plant palette of the great Japanese gardens could be described as a few visual highlights against green tapestries and layers. The prevailing color is green. Blooming plants are few and far between. Too many would be a violation of harmony and would shatter the mood of peace and repose so essential to meditation and spiritual refreshment. Besides, isn't the beauty and delicacy of a certain plant that much more beautiful when it isn't overwhelmed by a mob of competing blooms and colors. As the introductory haiku suggests, one flower is all that is needed to suggest spring.

A Final Note

The country is ruined: yet
mountains and rivers remain
It's spring in the walled town,
the grass growing wild.

(Japanese Haiku)

Presently the world is in the grip of an environmental crisis. And at its fundamental level, the environmental crisis is a crisis in perception in which the unity between all the world's parts, the oneness of man and nature, has not been understood or expressed by the dominant cultures. As long as cultures believe that earth and humans are separated from each other, that somehow humans are cast in the image of the sacred, but the earth is not, then it's easy to justify the plundering of earth to supply a culture based on material goods.

There hasn't been a landscape tradition that transcends the Japanese garden as an expression of the harmony of earth's parts, the oneness of all of life, the respect and reverence due to all of nature. We are drawn to the Japanese garden without really knowing why, but with deep and profound yearning. The garden is mysterious, green, unadorned, peaceful. We feel at home in these gardens.

Any long term solution to the environmental crisis will require a long journey in awareness. Doesn't then the Japanese garden embody both the journey and the destination? Isn't this its greatest lesson to us all? ❧

"Sand for Dry Garden"

Many of the articles in this handbook refer to dry gardens or sand gardens. It has been mentioned that the term sand is used loosely—it is actually gravel or turkey grit.

Washed gravel made up of uniformly sized particles can be raked into patterns but does not look satisfactory. By combining several sizes of poultry grit the proper combination of texture, light and shadow can be achieved.

2 parts "grower" size
1 part "turkey" size
1 part "turkey" finisher

(Turkey grit is available through livestock grain and feed stores.)

This mixture will hold the patterns raked into it while presenting the most pleasing effect.

(adapted from an original article, *Plants & Gardens*, Vol. 17 #4, 1961)

ZEN IN JAPANESE GARDENS

Kim Sorvig

THE STONE GARDEN at Ryoanji, Kyoto is a quintessential Zen garden. Such a garden (and there is at least a little Zen influence in every Japanese garden), is difficult and risky to try to "explain." It is a matter of sensing, of feeling – the "Aha!" of insight. When asked to explain, shallow symbolism is tempting but misses the essential point. Zen is about experience; personal, direct and unifying, and Zen gardens are expressions of that experience.

Zen is a sect of Buddhism which places total importance on meditation; indeed, the name *zen* itself comes from the Sanskrit word for meditation. This practice is not the passive contemplation of an external deity or truth. Rather, it is a dynamic, still "centering" of awareness, in which one has insight into and direct involvement in "truth," "deity," or "universal energy." This awareness is "beyond explaining," and even Zen's own scriptures laugh at themselves and at

Brooklyn Botanic Garden

In a Zen garden, rocks are rocks; the art of placing them is best learned by "listening to them" until we know where they want to be. The surrounding sand is raked and might suggest water as the rock might suggest an island.

anyone who memorizes or tries to read symbolism into them. Zen teaching is full of riddles (*koans*) that demand involvement, and one is often told to become *one* with the riddle; then the whole world unites behind a personal response to the *koan*, often immensely humorous, and seldom otherworldly. Nirvana, the great liberation, is to be found in *samsara*, the real-yet-illusory world of the here-and-now.

What does this have to do with gardens?

A garden is one of the most direct expressions of human attitude toward the universe and the living environment. Most Western gardens, until recently, have been based on the attitude that this world is one of sin and imperfection, from which an escape to a "paradise" is desired, or upon which an abstract ideal order must be imposed. Western gardens, by and large, are either idyllic escapes or geometric "improvements," and are very often highly symbolic of some heavenly or romantic vision, or of hierarchic order and power, or both.

The Zen attitude is quite different, and so are its gardens. By meditation one realizes that one is united with the whole world, but is neither so oppressed by it to want only escape, nor so all-powerful as to try to impose one's will on it. As expressions of this attitude, Zen gardens show the touch of human hands that accept, understand, and are harmoniously involved in the natural environment.

In such a garden, symbolism is superfluous — not unacceptable, but only a paraphrase not to be taken too seriously. The rugged "island" at Konji-in, in Kyoto, crowned with an ancient gnarled conifer, is not "symbolic of" long life — it is long life! The fact that it *also* resembles the shape of a tortoise, a long-lived animal, is a wonderful gloss, but only a footnote. Mistaking this graceful, humorous counterpoint for the fundamental melody is common, even among the Japanese. One Zen writing refers to this sort of nearsightedness as "slandering the sky by looking through a pipe."

In a Zen garden, rocks are rocks; the art of placing them is best learned by "listening to them" until one knows where *they* want to be. A human teacher or book can only help open one's ears so that one hears the garden more clearly. Plants are likewise plants. And human artifice is also just that, human activity seen in relief against the background of natural elements speaking for themselves. Humans, too, are natural elements; yet we are aware of the world, and awareness shapes us and the world both. Thus, where Zen hands alter nature, it is to clarify the natural event (as when trees are pruned or boulders juxtaposed to accentuate their unique forms); or to show human relationship to nature (as when a clearly cut, squared stone is introduced among naturally-shaped ones in a path). Both effects are very powerful, enough so that people brought up on the Western idea of humans-versus-nature often find the accentuated result "artificial," again completely missing the point.

In the Zen garden, every element is the whole, and is whole in itself. This is not because the rock represents a mountain, or because the garden symbolizes the world outside. Rather, it is because of a profound belief that the universe, the human mind, and the smallest, plainest flower or pebble are governed by the same forces, so that the microcosm is a macrocosm. This pervasive attitude in Japan, to which both Zen and Shinto contribute, is easily misinterpreted by Westerners as superstitious or symbolic. It is neither.

Not every Zen garden, much less all Japanese gardens, fully achieve this quality of "being what they are," but there is usually a trace at least. It may be in the illusions which remind us that perceiver and perceived are One — the tiny courtyard that feels like a forest glade, or the small window revealing a few bamboo stems which makes one believe that beyond the wall there is a vast jungle. It may be in the integration of interior with exterior, through borrowed landscape, or through the interweaving of house and garden spaces. It may be in the *absence* of things which suggest human meddling — the lack of gaudy double-flowered hybrids, the emphasis on the lasting forms of rocks and evergreens, the gentle poverty of means, the local materials, the keen observation and faithful suggestion of nature's handiwork. Being what they are, everything is The One. Those masterful gardens which fully express this are characterized by an immensely resonant depth, and inspire attentive, energetic quiet.

But beware of the lure of explanation. What I have written here is rubbish; "useful lies," some Buddhists call it. To truly understand the Zen garden, sit quietly in one, relaxed yet alert, until all explanations are forgotten and you and your environment become "not two, yet not one." Then you will know what I really should have said. ⁂

The white sand garden seen as one enters Tenryu-ji.

All photos courtesy of Claire Sawyers

WORKING FOR SONE-SAN AT TENRYU-JI

Claire E. Sawyers

Early one morning soon after I had begun working there, it was raining too hard to sweep the gravel walkways. I followed Sone-san (Mr. Sone) down to the lake to observe the garden. Looking across the rain-dappled lake to the rocks and trees that had taken on deeper hues, he asked me in broken English if I knew about the rocks creating an island on the far side of the water. Sone explained: the middle rock is the peak of Mt. Horai – the island of the gods and goddesses in Chinese mythology – barely rising above the cloud layer of lake water. While those, he indicated waving towards four low stones in a line, are ships tied in a harbor protected from a vast ocean. Sone drew the conclusion for me: this is the nature of Japanese gardens, within a few meters, a lake is two contrasting things simultaneously – lofty clouds and a vast ocean.

Through a ripple of events I became an apprentice for a Japanese professional gardener, Saburo Sone, curator of Tenryu-ji's gardens and grounds.

Many mornings, once Sone and the other workers arrived, we each armed ourselves with a broom made of bamboo twigs and swept the gravel towards the center of the walkways and collected the fallen leaves. Miura-san, the most advanced apprentice, also raked the white gravel garden every two or three days to freshen the pattern. Sweeping took until morning tea-time. When Sone indicated it was time to break, one of the others would run back to the work shed and prepare a tray with tea cups and teapot full of green tea. Sometimes we sipped for half-an-hour, but just as often, attempting to finish other work, we didn't break until lunchtime when we returned to our *bento* or box lunch of rice, fish and vegetable pickles.

Cleaning the paths was a frequent and predictable task, yet it provided no clues about the work

A majestic pine grows in front of the main temple at Tenryu-ji. Visitors can walk around the temple building to reach the lake or can slip off their shoes and step into the wooden veranda. Sliding doors open on three sides of the room making a perfect area for garden viewing.

lined up next. Jobs ranged from relocating a stone lantern in the enclosed garden of a subtemple to wiring-up bamboo poles around a dog pen for the head-monk. During those early spring months, we constructed two stone walkways. one circling a newly renovated pavilion on the compound's central avenue, the other beautifying monks' gravesites behind the main garden. We added several camellia and pine trees to the grounds; we dug bamboo shoots encroaching on the other parts of the garden as soon as they appeared; we drained and scrubbed the spring-fed fountain inside the garden periodically and collected the coins visitors had thrown in. On one occasion we drained the large H-shaped reflecting pool at the complex entrance to plant sausage-shaped lotus tubers in the mud. We constructed several of the fences during the spring with fresh green bamboo and once we sprayed the famous cherry trees with insecticide.

The Sone-zoen

I think Sone took me on partly for nostalgic reasons and partly so he could show-off his command of English. He had attended two years of college in Oregon many years earlier.

Sone and his two brothers were in the landscaping business together. His brothers as well as his wife and children lived in Osaka, about an hour away from Kyoto. Sone was establishing the business in Kyoto while his brothers built residential gardens and landscape projects in Osaka. He kept an apartment in Kyoto and maintaining the traditional apprentice system, his workers lived-in, receiving room and board as part of their compensation. Once when I was invited with them to a holiday party, I went to their Kyoto apartment for dinner before the celebration. We cooked and ate in one small room, while nontraditional bunk beds filled the other room (perhaps an idea Sone picked up from his American college dormitory life).

The Garden

On that rainy day Sone took me down to Tenryu-ji's lake and unshrouded Mt. Horai, the legendary island of the immortals, he willingly passed the rainy morning away telling garden stories that the other apprentices probably knew well from studies. Sone searched for the English to make certain I understood. Continuing with the rocks, he pointed to the opposite shore of the lake to the grey, jagged, lichen-covered stones which looked like a gushing mountain stream. It is known as *Ryu-mon-no-taki* which translates as "Dragon Gate Waterfall," the name of a waterfall of the Yellow River in China. According to a Chinese myth, golden carp struggle upstream in the Yellow River and if they succeed in ascending the falls they turn into dragons. Just at the foot of the waterless waterfall at Tenryu-ji, a stone known as the "carp stone" peaks its head above the lake's surface. There is a joke in this. In ancient China a person who became a government official by passing a civil examination was said to be a carp conquering the falls and becoming a dragon. The stone carp has looked longingly on the cascade at Tenryu-ji for centuries.

Sone went on to explain *shakkei* or borrowed scenery, a unique Japanese landscaping technique. The stones of *Ryu-mon-no-taki* so strongly suggest a mountain stream, he said, that a visitor looks to the surrounding mountains imagining the water source. In this way, the mountains become part of the garden.

Three naturally flat rocks bridge the lake in front of the waterfall. Sone explained that those stones bridging the imagined white water represent three sects of Buddhism – the Jugaku, Buyo, and Dokyo sects – thus they comment on religion's role in making life's difficulties surmountable.

Besides the distant Mt. Horai there is another rocky island on the near side of Tenryu-ji's lake. The sign staked on the mound reads "tortoise island" and with some imagination and Sone's help I could see a head poking out of the water and four limbs. The inanimate tortoise brings life into the lake, but more profoundly it brings longevity, since in Japanese mythology the tortoise lives 10,000 years. Tenryu-ji's tortoise island is uniquely connected to the lake's shore by an ornamental stone bridge. Was the designer suggesting Tenryu-ji is the bridge to longevity?

From the lake's edge we followed a delicately channeled stream to higher ground and came to the spring-fed fountain just behind the Zen meditation pavilion. We paused beneath two massive weeping cherry trees within hearing range of the gurgling water of the fountain. For the few early spring days the trees bloom, the garden overflows with visitors who come to gaze up through the green bamboo lattice which supports the sky of pink petals. I felt the fever of the pleased tourists who captured the blossoms in their prime. When I commented then about how disappointed the late-comers must have been, Sone disagreed. He said the Japanese understand the cherry blossoms' intense beauty is due to its ephemeral nature.

Tenryu-ji's History

Inside Tenryu-ji's garden, especially in the early morning before tourists arrived and while the monks' chimes and gongs softly penetrated the *shoji* doors, it was easy for me to forget the mod-

The Dragon-gate-waterfall (Ryu-mon-no-taki) is named after a waterfall in the Yellow River in China. According to Chinese myth, golden carp struggle upstream in this river and if they succeed in ascending the falls they turn into dragons.

ern Kyoto I had just traveled through and imagine the characters in Tenryu-ji's past.

Arashiyama, the area around Tenryu-ji, was popular as a resort as early as the 9th century, according to Loraine Kuck in *The World of the Japanese Garden*. Courtiers retired to the spot increasing its popularity and historians think that when emperor Gosago moved to Arashiyama permanently, the garden of Tenryu-ji emerged. Gosago's grandson, Godaigo (1287–1339) grew up there and following the pattern, became emperor.

Eventually courtiers abandoned the villa in Arashiyama. It declined and by then General Takauji was attempting to overthrow Emperor Godaigo and succeeded in pushing him out of Kyoto. The Emperor retreated to Nara where he suddenly died. Takauji feared revenge from the Emperor's ghost, but he eased the situation by following a suggestion from Muso Kokushi, monk of the nearby Moss Temple (Saiho-ji). Kokushi proposed the Emperor's spirit be enshrined at his old villa and childhood home in Arashiyama. The result: the Temple of the Heavenly Dragon or Tenryu-ji. Muso Kokushi became head monk of Tenryu-ji and some give him credit for the garden design as it stands today. Historians also debate whether the name of the temple refers to Godaigo as the "Heavenly Dragon" or if it alludes to the myth behind the rock waterfall in the garden.

Farewell

I worked for Sone two months, never really feeling a part of the crew since I was foreign, female, and wasn't living-in like the others. That distance disappeared when it came time to leave. On my last day of work Sone presented me with

a valuable memento of Tenryu-ji: a calligraphy piece brushed by the head monk. The characters read *shizuka* or "quiet" describing a zen-concept, but to me it also described the garden. After work, Sone, Miura and the others took me downtown and selected a souvenir of modern Japan for me – a wristwatch. On to a prestigious restaurant where we dined in a private room, consuming at least seven courses. Over dessert the other apprentices gave me books on Japanese gardens. They had filled the inside covers with characters which wished me luck.

The farewell party continued until early morning, and after all the songs they knew had been sung, they called a taxi for me. As I waved goodbye out the cab window, I caught a glimpse of my "souvenir-of-Japan". If I hadn't been leaving, it would have been nearly time to catch the bus for Tenryu-ji. ☙

Saburo Sone-san wears the traditional working garb: a simple shirt covered by *happi*, and baggy pants.

Elderly women swept and weeded at Tenryu-ji. Their costumes resemble their male counterparts except for headscarves rather than the male headbands. Everyone had tea together during breaks.

The H-shaped reflecting pool is located at the entrance of the complex. On occasion the pool is drained in order to plant sausage-shaped lotus tubers directly in the muddy bottom.

KOI: THE COLORFUL CARP OF JAPAN

Joseph S. Zuritsky

KOI ARE THE SAME SPECIES of fish (carp) that live in many of the streams and rivers of the Continental United States. They differ only by their colors. In China, the cultivation of carp for food and later for pleasure goes back over 2,000 years. Written instructions on the raising of carp date back to year 500 BC. Carp was cultivated because it grows fast, is extremely hardy and thrives in most of the climatic zones humans inhabit. After the introduction of carp from Asia Minor into China and then into Japan, the species started to attract interest. As time passed, color mutations appeared in the spawnings and these separated and then selectively bred to improve color and subsequently patterns. Thus, from the homely carp slowly emerged today's magnificent *nishiki koi*, or brocaded carp.

Over the years, the carp came to symbolize strength, wisdom, and courage to the Japanese and many legends grew up about their virtues. Since parents hoped their sons would possess the same positive traits as the carp, each May 5th, on Boy's Day, parents would fly one carp-shaped flag outside their homes for each of their sons. This tradition still thrives and May 5th is a colorful event with thousands of carp 'swimming' in the wind on flag poles above Japanese homes.

Koi can grow to be over three feet in length, weigh over 30 pounds (although most seen in gardens are about half that size) and live more than 50 years. They eat almost anything of animal or vegetable origin small enough to be swallowed as they have no external teeth. The finest quality koi are bred in Japan where raising koi is a $100 million a year business but the hobby of raising and showing koi has attracted thousands of persons in scores of countries.

Koi are bred primarily for the color and patterns on their backs because their backs are most visible as they swim in ponds. Koi are classified into color, pattern, and scale types, and although each type allows some leeway for originality and faults, the color, pattern, and body shape are specifically enumerated much the same way dogs are judged in the United States.

Each patterned koi is like a work of art; each is different, but as with art very few are considered masterpieces. Those few koi which become champions at the large shows in Japan *are* considered masterpieces and have sold for more than $20,000 each. The reason for the high values is that even the best quality koi do not reproduce high quality young in large numbers. Out of 200,000 newly hatched young, less than 200 will be of salable quality and often none of show quality. After the laborious task of culling thousands to find the special few, the tiny koi must be nursed through their first years of life when they are vulnerable to disease, parasites and predators. Changes in color and pattern also take place during this time.

Keeping koi healthy requires duplicating as closely as possible their natural habitat which means the water must be clean and unpolluted. A natural spring-fed pond is ideal as the water is continously changing and need not be filtered or aerated. Since conditions hobbyists must contend with are rarely perfect, artificial means have been devised so koi can be grown almost anywhere: homes, public places, businesses, indoors or out. Ideal artificial conditions include proper filtration, aeration, water depth, amount of shade, and adequate water changes.

In a Japanese garden, one might wish to keep 25 to 35 large koi (18 to 28 inches) in a pond measuring almost 10 feet by 20 feet with a depth of four feet. However, the natural oxygen level of this pond would not be sufficient to sustain that number of fish. To permit koi to survive in these conditions, the oxygen level of the water can be raised by either adding a vigorous waterfall or a mechanical aerator. In addition, if the water merely recirculates, it quickly becomes poisoned by fish wastes and decomposing food if adequate filtration is not provided. This can be accomplished by creating a biological filter in which aerobic bacteria in the filter consume fish waste and excess food, removing dangerous chemicals and purifying the water. The filter box should be constructed to route pond water through four to six inches of ¼ inch crushed granite. Within three to four weeks the aerobic bacteria multiply into sufficient quantities within the gravel bed to filter and purify the water and

Joseph S. Zuritsky

Koi (carp) are bred primarily for the colors and patterns on their backs—the parts most visible when swimming in pools. They are classified by color, pattern, and scale types. Koi can grow to over three feet in length and weigh over 30 pounds. Their lifespan can be more than 50 years.

will continue to do so if water passes through the gravel at the rate of two to four gallons per minute for each square foot of filter surface. Pumps should have about 0.1 horse power for each 1,000 gallons, so a 1-horse power motor should serve a 10,000 gallon pond.

Fresh water should also be added to koi ponds. Each week about 10% of the pond water should be removed and replaced by tap water. One way this can be accomplished is to allow a dribble of tap water to flow into the pond continuously with the excess water flowing into the overflow drain, but first find out if your water company adds chloramine plus chlorine to purify its water. If so, a system must be devised to remove the chloramine from the water.

Although koi can survive limited periods of temperatures as low as 25° or high as 100°F, they are most comfortable in 65° to 75° water with 68° being perfect. Quick changes in temperature stress the fish and leave them weakened and open to attack by bacteria and parasites. Ponds made in the ground are insulated by the ground and their temperature changes slowly. The key variable in moderating temperature changes is the depth of the water; the deeper the water, the slower the temperature will change. Most experts advocate a depth of four to five feet although it is possible to keep koi outside in slightly shallower ponds (not less than three feet).

Most ponds are constructed of reinforced concrete, but PVC or rubber liners are also usable as is any water-holding container which won't poison the water. Ideally, ponds should have rounded corners for good water circulation, smooth sides so as not to damage koi scales, and steeply-sloped bottoms (30° to 35° angle) with a bottom sump drain to eliminate solids and wastes from the pond without putting them through the filter. Steep sides also allow the movement of the fish and the water currents to move heavy solids into the bottom sump. The sump should be made so that the opening of a valve allows heavy wastes and dangerous ammonia, which also collects in the sump, to be drained into a sewer or french drain. Lastly, for clearer water without algae (green water) a skimmer should be incorporated into the pond, and the pond should be built mostly in the shade.

Koi are normally bottom feeders, but by feeding them floating foods they learn to feed at the surface where they can be appreciated. With patience, koi can be tamed and will even feed from their owner's hand. The addition of koi into a traditional Japanese pond provides the finishing touch of life and beauty to one of man's highest artistic achievements, the Japanese garden.

Koi dealers to contact for further information and/or Koi:

Asahi Fancy Koi, Inc.
1051 W. 190th St.
Gardena, CA 90247
(213) 532-2020

California Koi Farms, Inc.
3360 Gird Rd.
Fallbrook, CA 92028
(619) 728-1483

Koi Breeders
P.O. Box 4
Newberry, CA 92365
(619) 257-3653

Nishiki Koi
Fujiwara Shoten Ltd.
313 Santa Barbara St.
Santa Barbara, CA
(805) 963-4224

Quality Koi Co.
1355 Bobarn Dr.
Narberth, PA 19072
Joseph Zuritsky
(215) 563-3336 (day)
(215) 667-7340 (eve)

Gardena Koi & Goldfish Farm
816 West Gardena Blvd.
Gardena, CA 90247
(213) 327-2872 ☙

NOTEWORTHY BOOKS ON JAPANESE GARDENS

Elisabeth Woodburn

BOTH HISTORIC and contemporary views of a subject frequently show the bias of their times. To examine a subject via words and pictures of one period and then compare these images with a later time period is often an interesting comment on history itself. In the almost hundred years between Edward S. Morse's *Japanese Homes and Their Surroundings*, published in Boston in 1886 and the large, beautiful volume of Kanto Shigemori's *The Japanese Courtyard Garden*, published in New York in 1981, the gamut is run from the early describer of a mysterious far-away land for fellow occidentals, to a Japanese describing small gardens for possible emulators.

The number of books published between 1886 and 1984 show the continuing interest of the Western world in the way the Japanese use plants and nature to create gardens. The greatest—and the first—of all the books on various components of the five styles of Japanese gardens was by Josiah Conder. *Landscape Gardening in Japan*, published in 1893 in Tokyo, was followed in 1895 by *Supplement to Landscape Gardening in Japan*. These tall volumes have color illustrations (Japanese wood-block style), 40 heliographic plates, and pages of detailed drawings of fences, ornaments and paving so extensive that no one since has provided such a wealth of detailed information. A second edition was published in 1912. A paperback edition, reduced in size and without color plates was published in 1964. Most horticultural libraries will have this work but it is becoming difficult to find in book stores. It should be examined by everyone who wishes to see the style of Japanese gardens before Western 'interpretation'.

There are several other early noteworthy books on Japanese Gardens:

European and Japanese Gardens with the section on 'Japanese Gardening' ('Notes to the Lantern Slides') by K. Harada was published in Philadelphia in 1902. It was edited by Glenn Brown for the American Institute of Architects. The illustrations and brief factual text are informative and indicative of the precise nature of the symbolism.

The Flowers and Gardens of Japan described by Florence Du Cane and painted by Ella Du Cane was issued in London in 1908 as a volume in A. & C. Black's popular series of color plate books. The author states that although there are many books on Japan there was no book giving a short account of the flora of the country which is so often called 'The Land of Flowers'. She also says that most of her knowledge of the gardens is derived from Mr. Conder's work. She makes no mention of Sir Francis Piggott's *The Garden of Japan: A Year's Diary of Its Flowers*, also published in London, in 1892, with four color plates of flowers and a diary-type text which gives accounts of the Japanese appreciation of flowers and gardens throughout the year.

Another popular book of this period was Mrs. Basil Taylor's *Japanese Gardens* (London and New York, 1912) with 28 color impressionistic pictures by Walter Tyndale. Mrs. Taylor also acknowledged her debt to Mr. Conder. The continued demand for works on all aspects of Japan was reflected in the several reprintings of both the Du Cane and Taylor books. In this country the remarkable Japanese exhibit at the 1876 Philadelphia Centennial Exhibition sparked an interest in Japanese plants and gardens. These early titles continue to be pertinent as direct reports of what Westerners found most interesting.

At the same time these Western publications appeared, a number of Japanese published books on their gardens. They will not be included in this brief list as they are not common, however, many delightful volumes exist in Japanese. They are frequently small, specialized works on such subjects as stone basins, stone lanterns or paving.

Increasingly, the Japanese works have become available, either written in English or translated for us. Some Japanese works appear with names of plants in Latin or English, with perhaps a page of introduction in English as in the exquisite volume *Japanese Alpine Plants*, illustrations by Bunsai Ioki, with introduction and notes by Hideaki Ohba. This folio volume of 99 color plates of plants from Bunsai Ioki's rock garden was painted at the end of the 19th century and only recently published. It is interesting to note that because of the botanical accuracy of the plates, the Japanese feel this book shows Western influences.

Between the two World Wars there were several books published which were widely distributed. The following titles are mentioned for their lasting interest. Jiro Harada's *The Gardens of Japan*, which described the gardens chronologically, was well illustrated being one of The Studio Books and was published in London in 1928. Tsuyoshi Tamura's *Art of the Landscape Garden in Japan* covered history, principles and design with plans and over 190 photos. It was published first in Tokyo in 1935 and then in New York in 1936. The familiar little 'Tourist Library #5' *Japanese Gardens*, by Matsunosuke Tatsui, began as a paperback in the 1930s and was being issued as a hardbound volume still in the 1960s. Samuel Newsom's *Japanese Garden Construction* (Tokyo, 1939) was beautifully produced and is still as useful as when it came out. Loraine Kuck's *100 Kyoto Gardens* contained a map for visitors to these famous gardens when it was published in London in 1935. It also had eight color plates. The same author's *The Art of Japanese Gardens* (New York, 1940) was informative and popular for years.

Shortly after World War II the stream of books on Japanese gardens started with such titles as Mirei Shigemori's *The Gardens of Japan* (Kyoto, 1949) with many photos including 16 in color. These make an interesting comparison with today's color photography in Japan. As the years have passed, the interest in Japanese gardens, as evidenced in the publications mentioned below, has increased in scope. There is a rough division in those which appear now, as the practical how-to-copy works, aesthetic appreciation, and guide books. Almost all the titles have elements of each category. Using these frequently blurry divisions, the following is an attempt to group some of the interesting modern titles.

Guide books such as Marc Treib and Ron Herman *A Guide to the Gardens of Kyoto* (Tokyo, 1980) is almost a model for what a specific, informative small paper-bound volume can be. It is filled with background information, plans and visiting hours, both to aid in viewing and to remember. Two guides of a completely different nature are outstanding modern publications. *Imperial Gardens of Japan* by Teiji Ito has 210 pages of photographs (138 of them in color) by photographer Takeji Iwamiya and essays by several important Japanese writers. This sumptuous volume was issued in folio size in Tokyo and New York in 1970 (also later printings). *Katsura, A Princely Retreat* by Akiro Naito (Tokyo and New York, 1977 and 1982) is also a large volume covering one garden in depth with 94 color photographs, plans, architectural drawings, and a colored, folding map.

A book dominating the practical and beautiful category is Kanto Shigemori's *The Japanese Courtyard Garden: Landscape for Small Spaces*, (Tokyo and New York, 1981). Seventy-five of Kyoto's gardens are shown in 93 color photos by Katsuhiko Mizuno. The 81 architectural plans included give the perspective needed to translate the photos into usable ideas. This, too, is a very large volume, beautifully produced. A much smaller book in this practical category is Teiji Itoh's *Space and Illusion in the Japanese Garden*. It was written to show two techniques of Japanese garden design – "borrowed scenery" and "the great within the small" – and how to create their special atmosphere. It was originally published in Kyoto in 1965 in Japanese, appeared in English in 1973 hard-bound, and then as a paperback in 1983. Other useful books for practical garden planning are: David Engel's *Japanese Gardens for Today* (Rutland and Tokyo, 1959 and later printings) with many photographs showing specific points made in the text; Tatsuo and Kiyoko Ishimoto's *Japanese Gardens Today, How the Japanese Use Rocks, Water, Plants*, (New York, 1968) with over 200 photos with accompanying text; and Samuel Newsom's *A Thousand Years of Japanese Gardens* (Tokyo 1st edition 1952, 2nd ed. 1955) which makes its point page by page with a photo on the upper half and text below it interpreting the ideas. A final title in this category indicates the international scope of interest in these gardens. Tetsuro Yoshido's *Gardens of Japan* was translated from German in 1957. It, too, is well illustrated by photos, plans and drawings.

The aesthetic, or interpretive view is, of course, well taken in all the above titles. Three titles give special emphasis to this approach to Japanese gardens. Mitchell Bring's and Josse Wayembergh's *Japanese Gardens – Design and Meaning* (New York, 1981) is divided into sections which cover specific gardens, their particular style and how that is achieved. Masao Hayakawa's *The Garden Art of Japan* is a volume in The Heibonsha Survey of Japanese Art Book Series (New York and Tokyo, 1971, 1981 printing) which especially answers questions of historic background and meaning. Lastly, Loraine Kuck in *The World of the Japanese Garden: From Chinese Origins to Modern Landscape Art* (New York and Tokyo, 1968, 3rd printing 1982) presents good historic as well as modern views enhanced by 212 illustrations (44 of them in color). A brief bibliography included is helpful.

A complete collection of books about Japanese gardens in Western languages would fill a sizeable bookcase and keep a collector busy for many years. The titles mentioned above have been carefully chosen for their helpful information and illustrations and because they can often be found in horticultural libraries. They capture a glimpse of Japanese gardens for repeated savoring.

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JAPANESE GARDENS

PLANTS & GARDEN

BROOKLYN BOTANIC
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JAPANESE GARDENS

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BROOKLYN BOTANIC GARDEN RECORD

JAPANESE GARDENS

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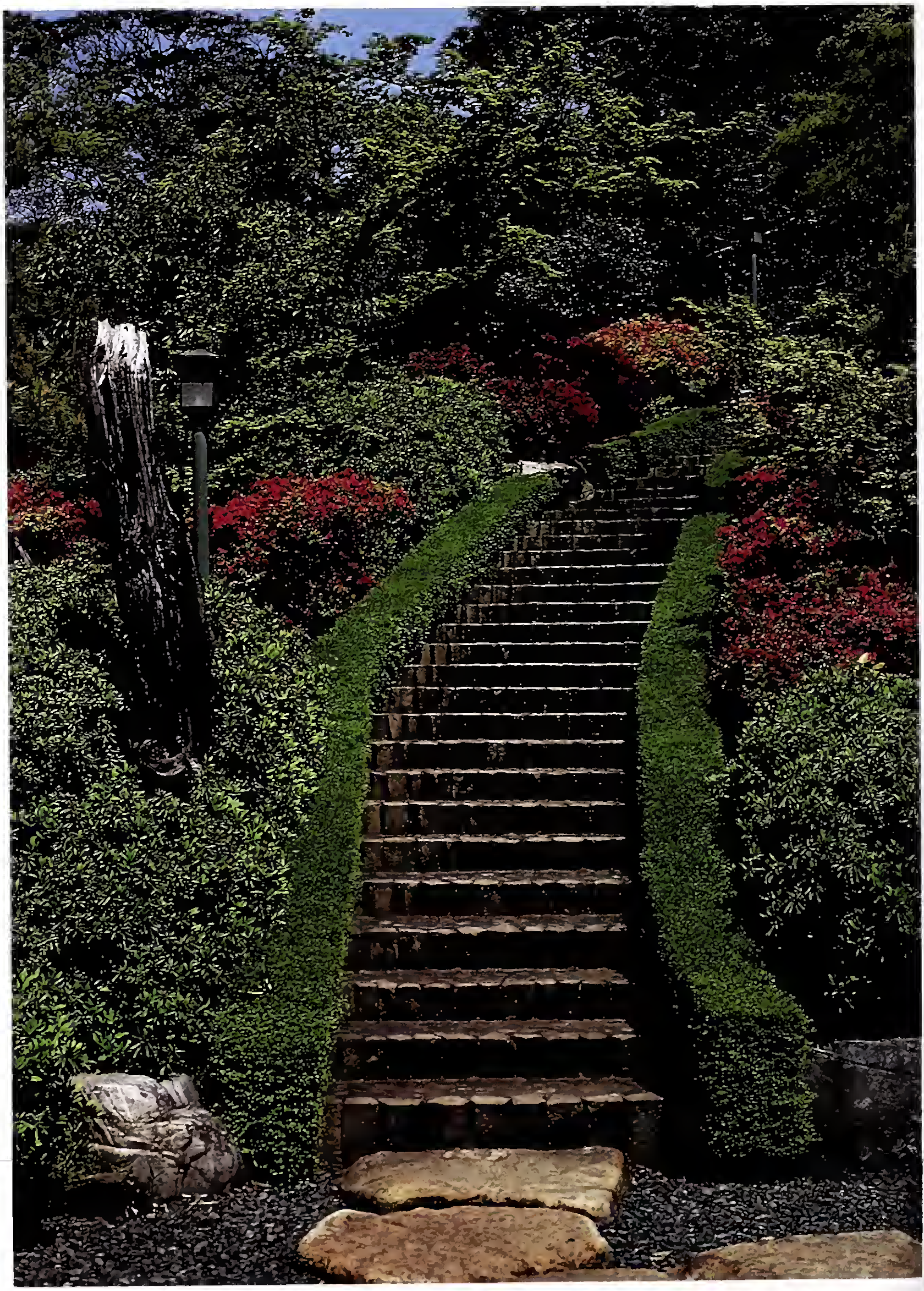
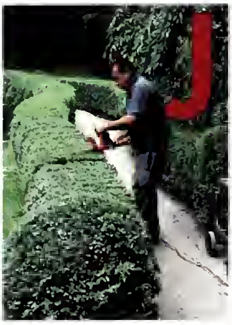


The steps of Mitsui Garden are bordered by clipped boxwood and blooming azaleas. PHOTO BY GEORGE TALOUMIS

LETTER FROM THE BOTANIC GARDEN

Barbara B. Pesch



Japanese views on gardening have been of major interest here at the Brooklyn Botanic Garden, and evidently to the readers of *Plants & Gardens* as well, for our handbooks on bonsai continue to head our list of best sellers. The previous handbook entitled "Japanese Gardens and Miniature Landscapes," completed in 1961, went through numerous printings before the present entirely new edition was completed.

In the pages that follow you will find many references to tranquility, peace, and quiet beauty. Perhaps it is the search for these qualities in our pressure ridden, fast-paced lives that generates the interest in Japanese gardens here in the States.

BBG's own Japanese Hill-and-Pond Garden was designed and constructed by Takeo Shiota in 1914-15 and remains today a focal point. Throughout the entire year this garden provides a panorama of peace and beauty. Flowers are used with restraint and the evergreen trees and shrubs, in association with rocks and water, present an ever-changing vista as paths are traveled. To the Japanese each garden is designed to mirror nature—it is a landscape in condensed form.

Claire Sawyers, who has lived and worked in Japan, has gathered together a particularly talented group of contributors for this issue. All bring expertise from their fields of concentration to enlighten the reader on every aspect of understanding the art of the Japanese garden. The contributors have related their personal experiences, personal viewpoints and opinions, and first-hand knowledge to provide new insights into this garden phenomenon. Sometimes it is easier to see through someone else's eyes than to see with our own eyes, and these authors indeed have keen vision.

Whether you wish to create a Japanese garden or just gain better understanding of their meaning, we wish you good reading and good gardening.

Above: Robert Gundacker, gardener in charge of BBG's Japanese Garden.

ROCKS, ISLANDS, MOUNTAINS, AND THE JAPANESE GARDEN

T. Kaori Kitao

A Japanese Garden may be created without flowers, grass, ponds, streams, mounds, paths, and even trees and shrubs, but a Japanese garden cannot exist without rocks. They appear in every conceivable size and shape and arrangement. There are boulders and fist-size stones, smooth or rough. Some are covered with moss, others are tall and soaring, while still others are flat and sprawling. They appear in rows or in clusters, strung out to form a water's edge and sometimes strewn in profusion to simulate a rocky landscape; or half buried in grass, they may escape our glance; or a single lonely stone, seemingly abandoned, may intrude into a path to draw attention. Rocks can be composed as a stone lantern, and carved to form water basins.

In Japan, rocks are not just rocks; they are privileged objects, objects that demand very special attention. When the Japanese discuss rocks, they discuss them with reverence, considering each rock individually, identifying features and exercising the critical discrimination of a collector of works of art. Shape, aspect, colors, and grains of each rock, and even its force and energy and the sense of presence are considered. Starting with the 11th-century manual, *Sakuteiki*, the art of choosing, laying and arranging rocks has been closely studied.

Rocks, Islands, Mountains

The fascination the Japanese hold for rocks is a deep-rooted cultural phenomenon, and its sources can be located in Japan's topography, mythology, and early literary iconography.

Japan is a volcanic archipelago, two-thirds of which consists of mountains. Its coastline is jagged, rocky, and strewn with innumerable islands. Mountains, islands, and rocks form a continuum as visual forms. Islands are, after all, rocky mountains in water.

Rocky coasts, on the other hand, are not unique to Japan. But the spiritua outlook of the Japanese toward the rock

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T. Kaori Kitao, *Professor of Art History, Swarthmore College, Swarthmore, PA, teaches a range of subjects. She is currently researching the Japanese garden as an index of Japanese culture.*

that surround them is something special, and Japanese mythology is informative on this point.

Rocks as Sacred Dwellings

Some of the oldest archeological remains in Japan, from the Middle Jomon Period (ca. 2000 BC) are arrangements of radially placed natural stones with an upright stone at their centers — unmistakably phallic in form and meaning. The belief was most probably that the god of procreation dwelt in the stone. In the Shinto worship, with its strong strain of animism, gods or spirits dwell in everything everywhere. In its most primitive form, however, the indigenous Japanese religion entertained the notion of mononoke — literally, "the spirit of things." Rocks were seen as the dwelling places of the deities. To this day there are certain rocks, individually or in a group, in the precincts of some older shrines, which are so designated with hallowed ropes and paper; they are called iwakura ("rock-seat"); or, if the whole area around is marked, iwasaka ("rock zone").

To the Japanese, then, rocks are ubiquitous, and yet they also invoke a sense of reverence and even religious awe as though they hold the mystery of life and nature. The ancient Japanese believed, in fact, that rocks grew. This idea is repeated in the poem which is sung today as the Japanese anthem: "may the nation live and thrive thousands of years till the pebbles have grown to be boulders covered with moss." To the Japanese rocks have always been simple and humble and yet divine, and at the same time awesome and familiar.

Literary Sources

Skeptics may still argue, however, that it is not uncommon in primitive religions that trees, rocks and mountains are imbued with mystery and viewed with awe.

The unification of Japan by the Yamato clan took place in the 5th century, and thence comes the earliest evidence of Japanese literature. The poets of the day praised the three mountains of the Yamato basin, Kagu and Miminashi, both male, flanking the female Unebi, none very tall but often seen floating above the mist which collects in the area. The Inland Sea with its numerous islands and rocky shores was equally important in the cultural life of early Japan because it was a chief channel of communication. Its image was surely well etched in the memories of many travelers and poets.

Garden as Island

The mountain is sacred in many other cultures as well. But in Japan, topography and mythology worked in consort to reinforce the literary iconography, and it is the merging of the mountain with the rock and the island that is unique and of special significance to the history of the Japanese garden.

In the writings of the 7th and 8th centuries (Nara Period), the garden was called *shima* which is the same word as "island." We know, too, that the earliest Japanese garden featured a mound and a pond and an islet connected to the shore by a bridge; Emperor Shomu (724-29) is said to have had three such gardens in Nara. Thenceforth, the garden, called *shima* or not, could not be conceived without rocks and mounds signifying not only islands but also mountains.

The Mountain of Immortals

To complicate the matter further, however, the influx of Chinese culture in Japan during the Nara Period gave the iconography of the island overlays of Taoist and Buddhist sources which concerned mountains. They are the *horaisan* and the *shumisen.*

Horaisan, or Mt. Horai, as understood in Japan, is a Taoist island-mountain of eternal youth, a sort of Elysium or Par-

Brooklyn Botanic Garden's own Hill-and-Pond Garden illustrates one of the oldest Japanese garden styles. Hills and a pond were created to suggest mountains and ocean.

adise. The legend goes that in 221 B.C. the first emperor of China, Ch'in Shih Huang-ti, dispatched Hsu Fu to Mt. Horai in pursuit of the elixir of life to be found on this island of immortals. But, as it happened, he landed in Japan and never returned home. He settled there with the youths and maidens who accompanied him and eventually died there.

Horaisan is, for the Japanese, the leg
endary Japan and yet a mythical place a
well, believed to be inhabited by crane
and tortoises, both creatures of excep
tional longevity, and covered with pine
peaches and plums, also known to liv
and grow for many centuries. These ar

all familiar themes that continue to recur in Japanese gardens as well as in literature, theater, and various festive and religious iconography.

Shumisen, or Mt. Sumeru, is the center of the world in Buddhist cosmology. It is a sacred mountain somewhat analogous to Olympus, the summit of which is the dwelling of Taishakuten, one of the 12 guardian deities. As early as 657 AD, according to the ancient chronicle *Nihongi*, a model of the mountain was constructed at the Asuka Temple near Nara. It was this stone "statue," known as yamagata ("mountain-form"), which shumisen referred to in particular in Japan, especially in garden design. The stone was actually excavated in 1902.

The *shumisen* and the *horaisan* have thus enriched the image of the rock as an island-mountain; and through the history of the Japanese garden, they remained fused in the general iconography of the rock.

Multiple Meaning

It always baffles Japanese to be asked what the rocks in Japan's gardens mean. For, on the one hand, there is no simple answer to the question; and, on the other, it seems so self-evident as to require no explanation. Used in the garden, a rock may be a *shumisen*, a *horaisan*, a particular island scene, or simply any mountain; or it may be just a rock, nothing more and nothing less. But whatever the specific reference, it cannot be understood free of the multiple images from the topographical, mythological, and literary history that constitute its iconography: the rock as island, as mountain, as holy place, as garden. Whatever its specific reference, the rock is something that immediately and inescapably appeals to the Japanese. And, for the most part, a Japanese does not have to be well read in classics or versed in mythology and archeology to sense that, for it is an iconography that survives — in the inevitable cultural circularity — in Japan's gardens, which serve as literature and mythology in living form. In this way, rocks form an integral part of Japan's collective memory — their multiple meanings implicit.

Bamboo spout carries water to a basin shaped like an old Oriental coin.

A stone with a hollow serves as a water basin.

BASIC JAPANESE GARDEN STYLES

STEPHEN A. MORRELL

When viewing a Japanese garden, first consider that several distinct styles exist. As with most garden styles, however, the influence of one style can be seen on another. In the West this is often planned; different styles of Japanese gardens are blended together in attempts to capture everything.

The Japanese describe many garden styles, but there are five basic styles. First is one of the oldest styles, the "Hill and Pond Garden," which constitutes the main body of Japanese garden styles of which there are many variations. Here nature is represented by artificially constructed hills and pond, suggesting mountains and ocean. Shrubs are trimmed to complement the undulating contours of mountains and clouds, as well as to maintain scale. Trees are kept pruned and trained to look old and windswept and a major portion of the garden can be seen from any one point. It is understandable why this style is prominent since it resembles the natural landscape of Japan.

Second, the *karesansui* or "Dry Landscape" garden, traditionally associated with Zen temples, is usually a small space created as an aid to meditation where nature is reduced and suggested using onl stones, raked gravel,* and a minimum o plants. The technique of *shakkei* or "borrowed scenery" is often used by incorporating a distant vista as a background o the design, thereby perceptually enlarging the size of the garden. (The borrowed scenery technique is also used i other garden styles.) In Japan, dry gardens are viewed from a veranda and no entered as this would ruin the delicat relationship and scale of the composition. Variations of this style are ofte found incorporated into other styles i the West.

Third, the tea garden or *Roji*, literall meaning "Dewy Path," is simply a stepping stone path modeled after mountain trail leading to, and providin a setting for, the teahouse. The path fe tures a stone lantern which is lit fo evening tea gatherings and a stone wate basin where guests rinse their mouth and hands in an act of purifying bod

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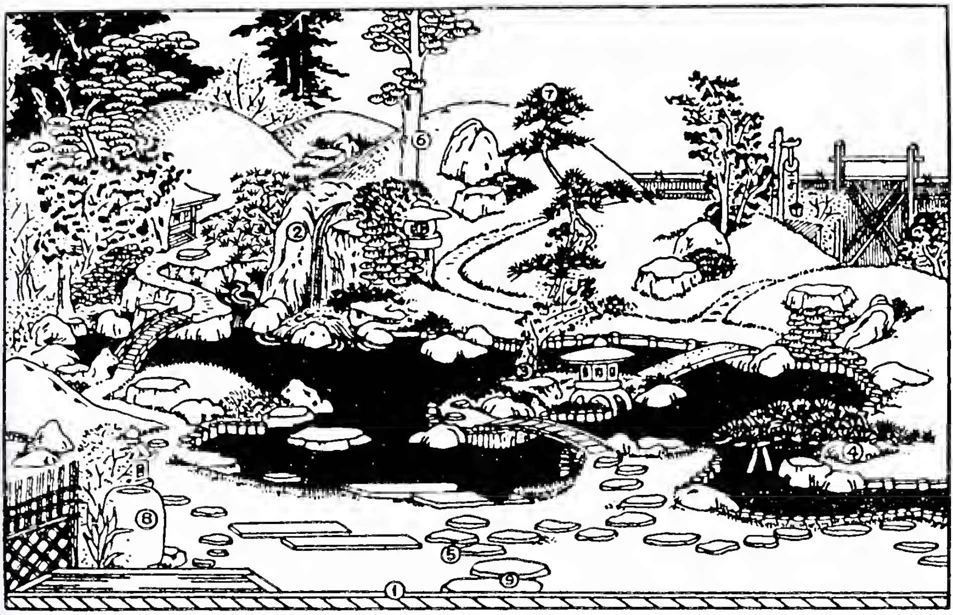


"SHIN" (ELABORATE) STYLE OF HILL GARDEN, FROM AN ILLUSTRATION IN "TSUKIYAMA TEIZŌ-DEN"

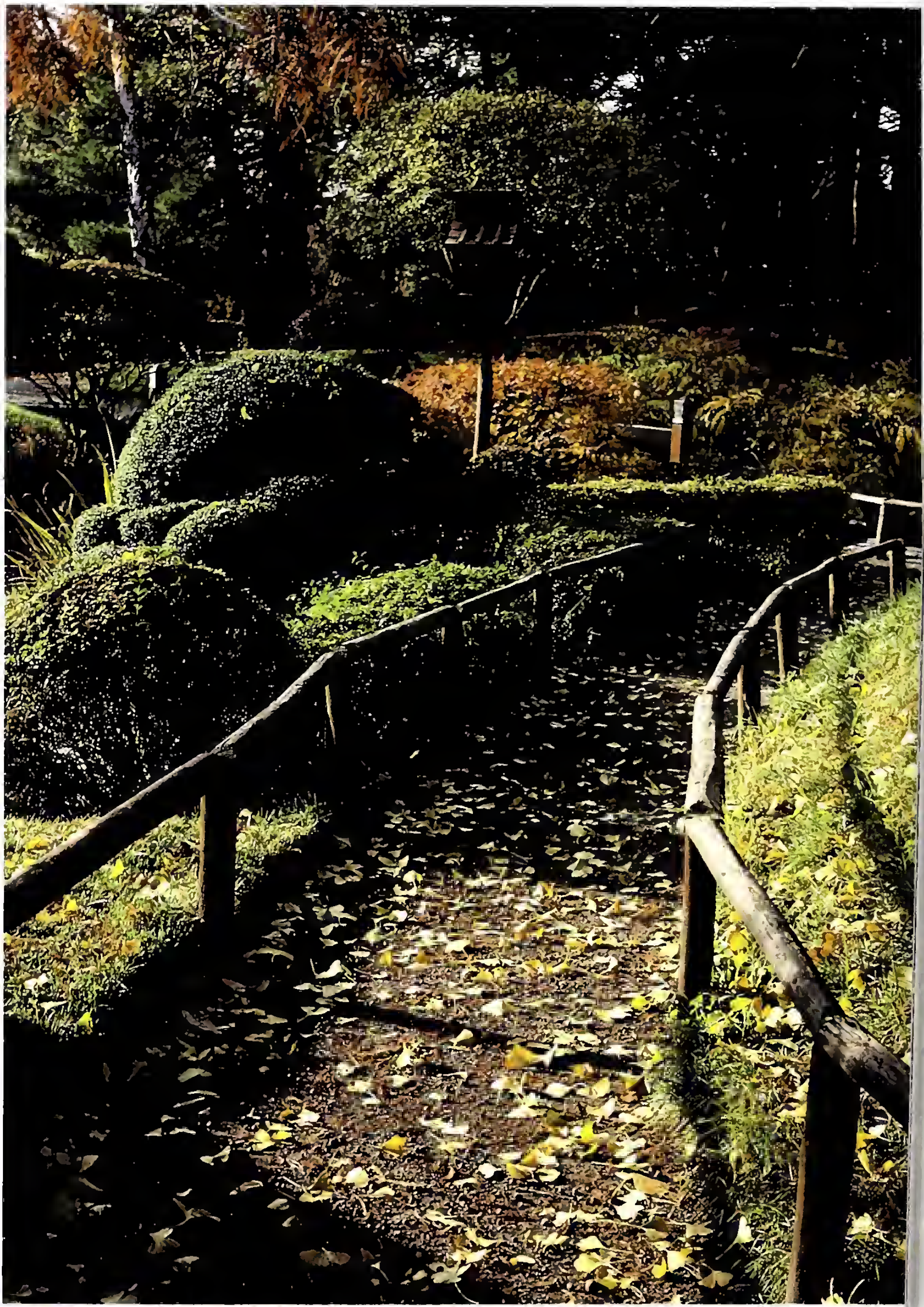
and mind before entering the teahouse. The use of stepping stones, stone lanterns, and water basins in gardens originated with the teagarden and these are common components in later garden styles. Plants in a teagarden are mostly evergreens creating a subdued atmosphere conducive to appreciating the tea ceremony. The teagarden and Dry Landscape garden, or variations of them, have become increasingly popular because their small size and simplicity make them practical.

The fourth style, the "Stroll" garden, takes advantage of tea garden techniques by incorporating stepping stones, stone lanterns, and usually a tea house or pavilion. Traditionally they were created by the nobility and designed on a large scale. Movement is around a pond and islands, employing the concepts of "Hide and Reveal" and "Movement Along the Diagonal." Rather than follow a straight axis, the path leads one left and right to reveal vistas gradually as one moves through the garden. Contrasting with the other garden styles, the entire Stroll garden cannot be viewed from any one point and requires active participation to experience it fully.

The fifth style, which is now very popular in Japan due to space limitations, is the "Courtyard" garden. Here, the strong influence of the tea garden and Dry Landscape garden can be seen. This style is not yet common in the West.

A Japanese garden strives to be true to the essence of nature, a beauty that is quiet and refined. It has a static quality which is maintained by the predominance of stone and evergreen plants, and yet is constantly changing. Through the passing of seasons, change is expressed, and over time quality and depths are reflected by the effects of weathering. The spirit of a Japanese garden is not easy to comprehend fully by viewing its physical elements only. The design encourages one to look deeper and complete the picture in one's own mind.

*Frequently the word "sand" is used in reference to *karesansui* gardens, but the gravel is more like a turkey grit.



A leaf strewn path in autumn at the Brooklyn Botanic Garden's own Hill-and-Pond Garden.

CLASSICAL PLANTS IN JAPANESE HORTICULTURE

Barry Yinger

Since the opening of Japan to the West in the last century, countless books and articles have been published about the aesthetics and practice of Japanese horticulture. Most describe and illustrate the Japanese gardens, especially those of the nobility or the great shrines and temples. Some of these works successfully illustrate and interpret the development of the gardens of the privileged, but they scarcely touch the heart of Japanese horticulture: plants. The Japanese people grow a staggering variety of ornamental plants, perhaps more than any other nation, and have at the same time conceived some of the world's most beautiful and emotionally evocative gardens by using a very limited variety of plants. Some very fine gardens use no plants at all. What do they do with all those plants? The answers to that question lead to the heart of Japanese horticulture.

The famous gardens of Japan have not been an immediate part of the ordinary Japanese citizen's horticultural experience. Until recently most important gardens were open only to the elite, and even now access to many is greatly restricted. In any case, very few Japanese families, past or present, have more than a tiny scrap of garden space; many have none at all. Instead they have used the odd spaces at curbside and balconies and fire escapes. There is no limit to the Japanese ability to maintain an exciting array of plants in cramped and difficult surroundings. I have seen tubs of Japanese iris (*Iris ensata* var. *ensata*) on grimy curbs in industrial neighborhoods, blooming pots of the orchid *Cypripedium macranthum*, and the shrub *Menziesia ciliicalyx* var. *purpurea* at the base of vending machines on a busy street; more than 50 selections of Japanese maple (*Acer palmatum* and *A. japonicum*) in rows of pots on the roof of a store; and nearly 100 different selections of the epiphytic orchid *Dendrobium moniliforme* in tiny pots in layered wire racks on the small balcony of an apartment house.

Koten engei Defined

Much of this pot culture of ornamental plants is simply horticultural exuberance, but some falls into the category of *koten engei*. The term *koten engei* is difficult to translate precisely, but "cultivation of classical plants" comes close. It is the cultivation of selections of a limited number of plant species in pots according to certain rules and conventions.

Koten engei is one of many branches of

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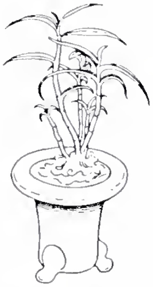
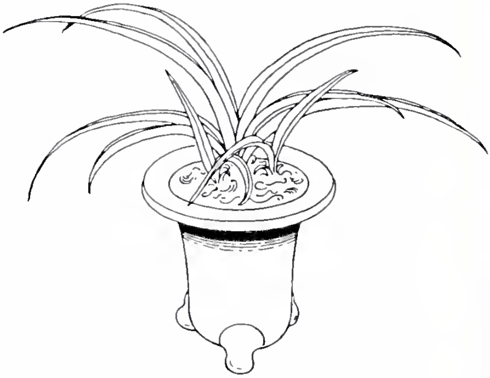
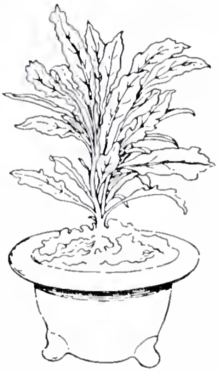






Above left:	*Dendrobium moniliforme*
Above right:	*Rohdea japonica*
Middle:	*Ardisia japonica*
Below left:	*Rhapis excelsa*
Below right:	*Psilotum nudum*

Drawings by Donald Emminger.
Used by permission of the author.

Japanese aesthetics in which a foreign model has been accepted, elaborated and gradually transformed into something distinctly Japanese. In this case, as in many others, the model was Chinese. Throughout Chinese history, selections of plants with showy flowers were grown in decorative pots to be used as temporary displays indoors and out. These plants, such as the peony (*Paeonia suffruticosa*) and chrysanthemum, were selected for color and form of their flowers. This concept was imported by the Japanese in the Heian Period (794-1192 AD) when Chinese influence shaped the aesthetics of Heian court society. Chinese-style pot culture was gradually transformed into the practice of growing myriad selections of certain species of native Japanese plants with subtle variations in leaf shape and pattern. The history of this transformation offers important insights into Japanese attitudes about ornamental plants.

The History of *Koten engei*

In the early years of the Heian Period the Japanese approach to aesthetics could be summarized by the concept of *miyabi,* best defined as "refinement and sophistication" from the point of view of a Japanese court society eager to isolate itself from the ignorant masses. The sumptuous elegance of court society in the Chinese style was a refuge not only from the common people, but also from the simple, rustic style of life that was later glorified by Japanese poets and artists. But the peace and stability of Heian times deteriorated into warfare and chaos as Japan endured nearly uninterrupted civil war from 1100 to 1800 AD.

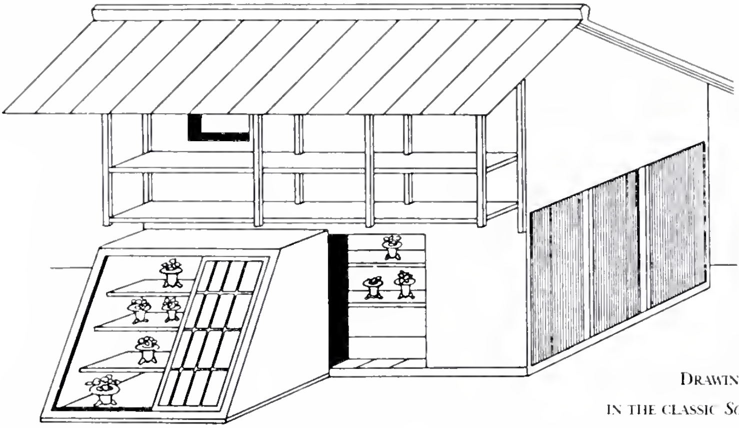
One reaction to the horror of war and social disorder was a new approach to aesthetics, sometimes summarized by the term *yugen* which marked a retreat from glitter and ostentation. *Yugen* emphasized the profound and mysterious, along with the value of simple forms stripped of distracting ornamentation. The term *sabi* also appeared, describing the pleasure which can be found in weathered or faded things.

This different approach came to be expressed in garden art and horticulture, and set the stage for the appreciation of the kinds of modest plants that came to be embraced by *koten engei.* The critical development that spurred this changed attitude toward beauty in plants was the development of the tea ceremony and its structure and gardens.

The tea ceremony developed as a peaceful refuge for men overwhelmed by the violence of their lives and times, leading them to a keen appreciation of a simple, rustic retreat within turbulent cities. The tea garden developed as a device to establish a mood of contemplation in the guests who passed through it to the tea house. Showy flowers were banished, replaced by humble herbs and shrubs which had previously been grown for medicinal and religious reasons near the dwellings of commoners and in the precincts of *Shinto* shrines. The sophisticated urban dweller now rejected the glittering complexity of the Heian court in favor of rustic materials and a simple style of floral decoration. Most of the species of plants which came to be part of *koten engei* were grown, or were suitable (in their original form) to be grown in the tea garden.

In 1603, Japan was united under the first Tokugawa *shogun,* Ieyasu, who ruled from the new capital at Edo (Tokyo). He and subsequent Tokugawa *shoguns* stimulated the development of the cult of *koten engei.* Ieyasu himself was an avid collector of plants at his home at Suruga. One of those plants was *Asarum* (wild ginger), which was also depicted in the family crest of the Tokugawa family.

Ieyasu's successor, Hidetada, also an



Drawing is based on a design in the classic *So Moku Ki Hin Kagami.*

A structure for the display and winter storage of *koten engei* plants. The wide roof on the display section protects the plants from the afternoon sun.

avid plant collector, ordered officials throughout Japan to bring him unusual plants. The custom of presenting plant mutations to the *shogun* quickly spread throughout the ranks of *samurai* and powerful citizens. We can be sure that *Asarum* and other *koten engei* subjects were among the plants presented.

The third *shogun*, Iemitsu (1623 to 1651) was an even more avid plantsman than his predecessors. A book of 100 camellia cultivars, *Hyakuchinshu*, was published during his rule. Most important was his establishment of the system of alternate residence, under which all the landed nobility throughout Japan were required to spend part of each year in residence in Edo (Tokyo). Iemitsu encouraged these vassal *daimyo* to bring interesting plant mutations to Edo and assemble to discuss them.

The system of alternate residence stimulated the rise of a class of educated, moneyed commoners on the fringes of this uprecedented concentration of idle *daimyo* and their many retainers. The development of the "floating world" (*ukiyo*) to provide for their entertainment and comfort stimulated the democratization of art and entertainment. *Kabuki* theater, *haiku* poetry and woodblock printing (*ukiyo-e*) owe the strength of their popularity to the vigor and interest of the rising middle class.

Two related developments in ornamental horticulture are characteristic of this period in Japanese history: the evolution of the courtyard garden (*tsuboniwa*) and the rise of the mania for collecting mutations and variations of ornamental plants. Urban commoners, lacking the spacious estates of the nobility, distilled the tea garden into the *tsuboniwa* to make use of small enclosed spaces among their houses. They retained the most emotional symbols of the tea garden: the stone lantern to light the way, the stepping stones to provide an unsoiled path, and the water basin to clean hands and mouth. This simple garden might be almost bare of plants, or include at most a few subdued trees, shrubs or herbs.

This movement to sparse, emotionally-charged gardens directly contradicted the simultaneous development of interest in the often bizarre mutations of a wide variety of plants. Because such plants had no place in the garden, and because collectors wished to grow many different kinds of plants in a very limited space, their mutations were normally grown and displayed in small pots. Weak or slow-growing selections were more suitable for long-term pot culture than vigorous relatives.

The Conventions of *Koten engei*

It is hard to say when unrestrained collecting of plant mutations came to be so ruled by convention that *koten engei* could be recognized as a distinct horticultural movement. We, like the Japanese who tried to define the movement in the last century, can only consider it in hindsight. Those who collected mutations in the past three centuries probably did not realize the rules they composed for selection and cultivation of mutations would become the conventions of a persistent horticultural movement. As there is no chronicle of the ideas and emotions of those who developed *koten engei*, we must look to the characteristics of the *koten engei* plant groups that have persisted to the present to understand it.

The following species are the original forms which have spawned the groups of selections most commonly grown as *koten engei* today:

Ardisia japonica (yabukoji)
Ardisia crenata (manryo)
Asarum spp. *(saishin)*
Cymbidium goeringii (shunran)
Dendrobium moniliforme (chosei ran)
Nandina domestica (nanten)
Neofinetia falcata (fuki ran)
Psilotum nudum (matsubaran)
Rhapis excelsa (kannon chiku)
Rohdea japonica (omoto)
Selaginella tamariscina (iwa hiba)

These species share several features:

1. All are Japanese natives which in their original forms are not showy.

2. The cultivated variants of the species are selections (aberrant forms) rather than hybrids. Except in some selections of *Cymbidium* and *Neofinetia* (orchids), selection is for characteristics other than flower form and color, and even those selected for floral characteristics are not very showy. Most selections are for variation in leaf form and color, especially variegated patterns. Many of the variations would be considered inconsequential by Western standards.

3. The selection of variants is not haphazard. Different kinds and degrees of variation have been classified and given names, and some are judged more desirable than others. Usually those aberrations which weaken a plant's constitution and increase its dependence on its grower's skill are most desirable.

4. The selections are always grown and displayed in pots, not in the garden. The traditional pot is of *raku* ware, a thin porous container fired at low temperature, with a rough surface and a shiny black glaze. The pots are decorated with a gold rim and feet (*fuchikin*), waves and birds (*nami-nishiki*), or elaborate patterns of flowers or fantastic animals (*nishiki*).

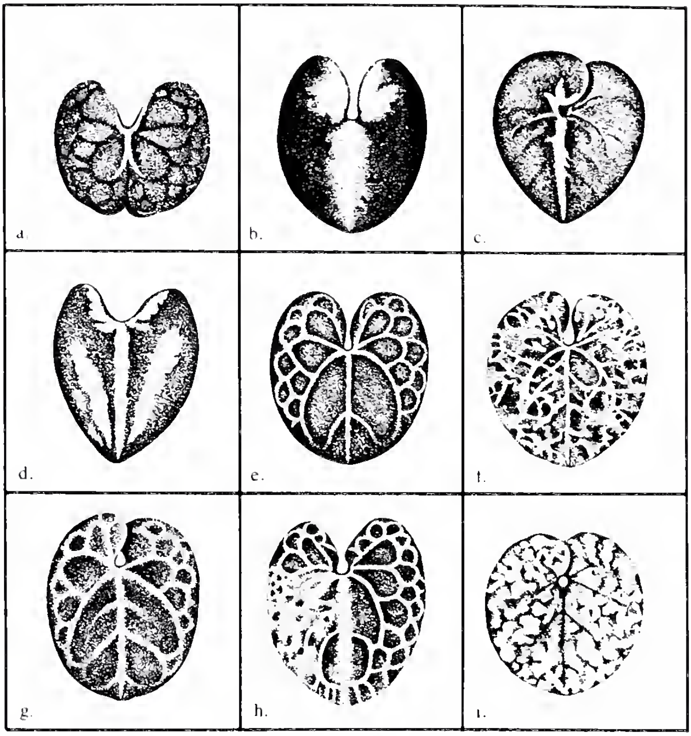
5. The selections are assigned names which are usually metaphorical, or sometimes allusions to places or events in classical Chinese history. These names are usually written in Chinese characters rather than the Japanese phonetic systems (*kana*).

6. The cultivars are evaluated by societies of hobbyists who deal with the selections of one species. The results of evaluation are periodically published on a chart called a *meikan* which resembles the traditional scoreboard (*banzuke*) of *sumo* wrestling.

7. Interest in the various groups is cyclical and has been accompanied by waves of intense financial speculation as prices rise in times of popularity.

The Cultivation of *Asarum*

The development of *koten engei* as a horti-



Some leaf characteristics (*gei*) used in classification of *Asarum* selections.

a. *biri o otsu*: leaf tip strongly relfexed, *uchidoshi*: deeply sunken veins

b. *tamafu*: large central variegated area (jewel variegation)

c. *tani* and *cha*: central stripe and markings at base (valley and butterfly)

d. *sagari fuji*: diagonal stripes of variegation on both sides of the leaf (hanging wisteria)

e. *kikka*: large network of variegation following veins (tortoise shell)

f. *nagarefu*: irregular indistinct variegation

g. *eriowase*: overlapping basal lobes

h. *zu*: asymmetrical yellow or white irregular variegation (map)

i. *gomafu*: small regular spots of variegation (sesame variegation)

cultural movement can be better comprehended by looking closely at one of the groups cultivated such as *Asarum* (wild ginger). Japanese awareness of *Asarum* dates to the beginning of Japanese history, as seen by the carved *Asarum* designs at the eaves of ancient buildings. These designs were thought to protect buildings from thunderstorms and earthquakes. The species of *Asarum* which is of most interest in the development of the selections, *Asarum takaoi*, grows in profusion at the approach to the grand shrine at Ise, the most revered of ancient *Shinto* shrines. *Asarum* can be seen growing in a variety of gardens in Kyoto where quiet, rustic, understated elegance characterizes the plantings. Its religious and ornamental importance is entwined with its medicinal properties, and it is still important in Chinese-style pharmacology. *Shinto* priests, like their Korean *shaman* predecessors, decorated their costumes and headdresses with *Asarum* leaves.

Koten engei in the U.S.

What does *koten engei* have to do with the All-American Gardener? Probably more than you realize. The Japanese garden as a setting for mental repose, and the involvement in close-up cultivation of highly dependent plants have taken root in Japan largely because of their role in "stress management" in crowded urban societies. Quiet retreats and "high-touch" horticulture are as relevant to American urbanites today as they were to ravaged *samurai* in Nagoya.

THE TIE BETWEEN JAPANESE ARCHITECTURE AND GARDENS

HARRIET A. HENDERSON

Japanese architecture and gardens are characterized by highly integrated indoor and outdoor spaces. This integration can be traced through the history of Japanese buildings and gardens.

Historical Development

Shinto and Buddhist religions greatly influenced the form of Japanese gardens and architecture. To summon the Shinto *kami*, gods believed to dwell in mountains, rivers and throughout the natural environment, a holy space was prepared. Consisting of four wood columns marking a square on a plane of white sand, this sacred space influenced the development of Japanese dwellings and the dry landscape gardens known as *karesansui*.

The arrival of Buddhism in the 7th century brought Chinese architecture and city planning, with vermilion red buildings grouped symmetrically along north-south axes. Gradually, the Japanese assimilated and transformed these symmetrical arrangements to accommodate the natural mountainous topography. Buildings were placed on diagonal axes, with the staggered structures creating spaces for gardens around each pavilion. As the vibrant Chinese colors were replaced with the natural Japanese wood surface on the structures, the formal Chinese courtyards gave way to more informal and asymmetrical Japanese gardens. Gardens in the 8th to 12th centuries typically represented a Buddhist paradise with a pond and flowering plants, and they were also enjoyed for boating and poetry readings.

During the 13th and 14th centuries, architectural innovations included *shoji* sliding doors (opaque paper panels within wood lattice frames) and *fusuma* (paper covered sliding panels, which were often painted). Rounded columns replaced the four square columns which established the corners of a room. Eventually, *tatami* (woven floor mats about 3 feet by 6 feet) were used as floor coverings, and the dimensions of the assembled *tatami* determined the overall shape of the room.

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This Memphis house and garden are tied together by the use of natural materials — bricks and wood. The collection of bonsai fits nicely along the rails of the porch.

In the 15th and 16th centuries, Zen Buddhism reached the peak of its influence. With its emphasis on simplicity, Japanese architecture and gardens became increasingly subdued. In temples, rock and sand gardens with evergreen plants were preferred for contemplation and meditation. Designed to be viewed from the building in a kneeling or sitting position, some gardens expressed the stark beauty of Chinese landscape paintings, while others reflected the Zen asceticism through abstract compositions.

Following the Zen philosophy, founders of the tea ceremony modeled the tearoom after the rustic thatched roof farmhouse to create an atmosphere of seclusion from the rigid patterns of daily life. The path to the tearoom was designed to evoke the feeling of a journey to a mountain retreat. Out of this tradition, with its emphasis on the pathway and movement, developed the stroll garden in which pavilions, usually located around a pond, were linked by paths.

Throughout Japanese history, the design of the architecture and gardens has been influenced by the climate and the abundance of natural resources. To ease the humidity of the summers and the threat of earthquakes, the houses are elevated 1-1/2 to 2-1/2 feet above the ground on wood columns, with flexible partitions. The sliding screens are adjusted to create large or small open spaces according to the season and to frame views of the garden. Large overhanging roofs of clay tile, wood shingles or thatch provide relief from the sun and rain.

The enclosure of the house and garden by a wall or fence, the area under the eaves and the sliding partitions of

The viewing pavilion in the Brooklyn Botanic Garden's Japanese Garden represents the home of the host and affords the best views of the garden.

buildings are three important features which illustrate how traditional Japanese buildings and gardens are integrated.

To create a private domestic space separated from the densely populated outside world, each lot is surrounded by an enclosing wall, fence or hedge that is above eye level. The house and garden are linked by the surrounding enclosure. The materials used reflect the natural resources readily available and set a tone of formality or informality. Stone walls and tile-topped clay walls tend to be formal and architectural, while wood, bamboo and reed fences vary from geometric to asymmetrical patterns. Hedges are often used in combination with open weave bamboo fences as a subtle transition from the garden to the enclosing edge. Berms also screen unwanted views while providing a change of topography within the garden.

The Japanese also enclose the garden to frame desired views with walls, fences, and plants. Focusing on a neighboring tree, nearby hill, or landscape feature gives the illusion of a larger garden by "borrowing scenery," or *shakkei.*

Another example of enclosure which links the building to the garden is the sleeve fence — a direct extension of the building. Made of bamboo and dried reeds, this fence has dimensions which are generally five to six feet high and three feet wide. The sleeve fence leads the viewer's eye from the building out into the garden, and it makes a transition in materials from the planned wood of the structure to the plants in the garden.

In the area under the eaves, the second important feature, the line of the roof overhang is repeated on the ground in stone, as a 12 to 18 inch wide gravel band edged with cut stone or rock. This run-off area for drainage is as decorative a part of the garden as it is a functional part of the house. Ornamental bronze or iron rain-chains hung from the overhang corners act as vertical accents and allow rain water, dancing down the chains, to become a decorative garden element. As these gravel and stone bands follow the rectilinear building lines, a contrasting stepping stone path with an irregular pattern leads from the garden to the edge of the house. The stepping stone at the building entrance is used for placing shoes before entering the house, and it is larger and higher than the other stepping stones.

Traditionally, the wood columns of the house and the posts supporting the overhang rest on stone bases to protect the wood from moisture. A natural rock or cut stone column base is often used today as a decorative transition from the architecture to the garden.

A raised wood veranda, typically under the overhang, can be used as an extension of the living area, or as part of the garden since it generally has no handrails. The bamboo and wood used for the veranda contrast in texture to the *tatami* and *shoji* of the interior, while harmonizing with the exterior rocks, plants, fences, and stone walls.

When the space under the eaves is kept at ground level, it assumes even more of the character of the garden. A change of surface to cut stone or gravel often occurs in this intermediate area to indicate the transition from the exterior to the interior. In some cases there is a complete integration of house and garden with plants brought into the vestibule area as part of a flush planter or in containers. There, the steps inside signal the beginning of the interior spaces and the location to place shoes.

Screening devices, such as rattan blinds known as *sudare*, are often hung from the eaves to shield the veranda from sunlight or unpleasant views. They provide ways for the inhabitants to see or experience nature, while still protecting them from the elements.

In both the veranda and vestibule areas, moveable wooden shutters, glass panels, and *shoji* screens further blend the interior and exterior spaces. All of these sliding partitions extend from floor to ceiling, and when opened provide uninterrupted expanses for viewing the garden. The outer heavy wood shutters provide protection, privacy, and insulation at night, but they can be opened and stored in the wall during the day. Glass doors with wood frames provide views of the garden, while shielding the interior during inclement weather. The *shoji* can be drawn back to open an entire room to a garden panorama, with the interior wood hewn columns echoing the tree trunks in the garden. With equal ease, *shoji* can also be partially closed to frame a specific garden feature. When completely closed, the *shoji* transmit soft, filtered light, and the pattern of branch and leaf shadows cast on the sliding doors still reveals the presence of the exterior landscape.

The integrated design of Japanese architecture and gardens offers many interesting ideas on how to fuse houses and gardens. The transition from the house to the garden is made by moving from refined materials with architectural designs, to rough hewn and natural materials with asymmetrical patterns. Innovative ways of enclosing indoor and outdoor spaces are shown with an array of fences, walls, and partitions. An intermediate space of a veranda or vestibule extends the garden into the house, and the house into the garden. The flexible partitions not only delineate the space and views from room to room and from room to garden, but also allow an openness and unity between the interior and exterior.

JAPANESE GARDENS

THE VIEW FROM THE WILDERNESS

JOHN L. CREECH

There is a special aspect of Japanese gardens that commands attention from the moment one sets foot through the garden gate. The array of plants evokes a feeling that each garden builder has a communion with nature. But what else would one expect from a people whose entire gardening tradition has been nature oriented.

From earliest times, the Japanese have been on intimate terms with their natural landscape both from a philosophical and practical viewpoint. That relationship was intensified by some 230 years of seclusion from about 1636 to 1868. During that era, the Japanese applied several centuries of Chinese influence to their own rich flora and added a devotion to detail that, in the case of garden design, produced some remarkable results.

From scores of wild plants, hundreds of improved varieties were selected and described and, in the instance of azaleas, over 300 selections appear in the *Kinshu Makura* — the first book written on this popular garden plant in 1692. In 1845, a samurai, Matsudaira Sakinko, wrote the first basic book on *Hana Shobu (Iris kaempferi)*. He discussed how he found his first seedlings in the mountains near Fukushima (probably the Adzuma mountains), and he described details of culture, fertilization, how to raise seedlings and control beetle damage to the flowers.

Hundreds of books on the ennobling of wild ornamental species appeared during this period. Some are simple discussions of single plants, others are practical guides to the culture of flowering plants, and still others are complete encyclopedias, such as one with 96 volumes covering a range of subjects from medicinal plants, poisonous plants (azaleas are included here), and economic plants to ornamental and forestry species. Books on bonsai and flower arrangement were common as were those discussing how to use plants, stones and water in the garden.

It is no accident the Japanese were drawn to their wilderness. The mountainous terrain demanded that crop production areas be close to the forest, and farmers drew upon these natural

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Ritsurin Park, Takamatsu, Japan PHOTO BY GEORGE TALOUMIS

resources for fuel, timber, medicine and food supplements. Gradually planted forests displaced natural stands and *sugi* (*Cryptomeria japonica*) occupied the lower and more favorable sites while hinoki cypress (*Chamaecyparis obtusa*) was planted on higher and drier locations. The change was so gradual that probably little of the native flora was permanently displaced as a walk in an old *sugi* forest will show. In addition, shrine and temple forests tended to rely on the natural stands of trees and afforded protection to other plant life. Giant bamboos, introduced from China at an early era, appeared in the company of the native tree species to form a close knit support system for the farming population. As they worked in the forests or climbed the volcanic peaks in search of religious truths, the highly observant people collected attractive and unusual forms of flowering plants to enhance their temples, shrines and gardens. Being equally adventuresome businessmen, many farmers began to grow seedling trees and shrubs to replenish the forests and to provide plants for the feudal nobility who were engaged in beautifying their castle grounds. For example, when Edo (Tokyo) was destroyed by fire in 1657, the Shogun decreed that there be a massive tree and shrub planting program to revitalize the city. Many farmers around Kawaguchi and Angyo, just north of the city, became engaged in the nursery business to meet this demand for plants and thus began the famous nursery center which exists today.

These opportunities came about partly as a result of Japan's exceedingly rich flora of over 5,000 species of higher plants and the fact that broadleaved evergreens and conifers are major components of this flora. These are distinguished through a range of natural landscapes, from exquisite coastal barrens with windswept pines, a mixture of broadleaved trees and shrubs, and carpets of junipers, to rugged mountain panoramas with grand associations of azaleas, camellias and hollies which draw vast audiences of viewers.

The Japanese are so infatuated with these scenes that ship captains pass close to small islands in the Inland Sea so passengers may enjoy an appropriate view. But the variation is endless and no matter how many times one makes the journey to Japan, new adventures into the world of plants are in store.

Knowing about the natural landscapes of Japan is an aid to appreciating the Japanese garden, since native species have been used almost exclusively in their development.

Origin of Japan

According to legend, the islands of Japan were derived from the activities of the Gods who enjoyed life in the Plain of High Heaven, among whom were Izanagi and Izanami, husband and wife. Among his many heroic gestures, Izanagi once threw his jeweled spear into the deep and as he withdrew it, a shower of brilliant drops fell from the spear to become the verdant dragon-shaped island group we call Japan.

Instead of showering down, the islands were thrust up from the Pacific Basin as the peaks of submarine mountains that arose over a period of 60 million years from one of the deepest trenches in any ocean basin, with depths reaching 30,000 feet. In an unstable region, Japan experiences numerous volcanic eruptions and earthquakes.

Because of this dramatic origin, Japan is immensely rugged, consisting of over 75% mountains and hills with steep slopes. Although the mountains are not especially high (Mt. Fuji being the highest at 12,461 ft.) there are dozens of mountains above 10,000 feet elevation, especially in the Japan Alps. These mountains are covered with luxurious forests and this green mantle is one of the lasting impressions of Japan. Because of Japan's unique geography, as an island chain running somewhat north-southwest off the coast of Asia, a moderate climate with ample rainfall prevails and the cool mountains contain a high proportion of broadleaved evergreens, trees, shrubs and groundcovers. Therefore all of the main elements essential to the Japanese landscape garden were readily available and in combinations that were often copied by the garden builders.

Wilderness Areas

The main sources of landscape materials are now preserved in the modern national park system of Japan and it is there one finds the natural landscape beauty reflected in gardens. There are 19 national parks and an additional 20 prefectural, or quasi-national parks, and 3 national gardens, the latter being the Imperial Palace Outer Garden, Shinjuku Gyoen and Kyoto Gyoen.

A trip to some of these areas will provide the gardener and traveler alike with background and ideas. The range of plant materials, outstanding landscapes, mountains and rocky coastlines seem endless. Visits to forests will reveal many remarkably fine plants not necessarily used in Japanese gardens and yet of interest. Beach areas are often covered with daylily species blooming in the summer. But the evergreen aspect of warmer Japan is gone.

There are so many treasure spots in Japan that many trips are essential to complete the story and witness the beauty of the four seasons as they relate to the Japanese garden. Fortunately the conservation system in Japan and the extent of these natural treasures assures that they will exist for a long time.

RECOMMENDED PLANTS FOR JAPANESE GARDENS IN AMERICA

STEPHEN A. MORRELL

Listed below are plants that are native to Asia and North America with an emphasis on Northeast Asia and eastern North America, as these two temperate floras are very similar with many identical species and related counterparts.

Using native plants of your area in addition to Japanese plants as a blending of two harmonious floras is in keeping with Japanese garden ideals.

This list is certainly not all-inclusive; varieties and cultivars are endless. In all cases a plant's hardiness rating should be considered for your area, as well as other cultural requirements.

EVERGREEN GROUNDCOVERS	**COMMON NAME**	**COMMENTS—NATIVITY**
Arctostaphylos uva-ursi	Bearberry	Eur., N. Asia, N. Amer.
Asarum shuttleworthii 'Callaway'	Wild ginger	SE U.S.
Galax urceolata	Wandflower	SE U.S.
Leucobryum glaucum	Cushion moss	Circumboreal
Liriope muscari	Lilyturf	Japan, China; numerous cultivars
Pachysandra terminalis	Japanese spurge	Japan; *P. procumbens* is an American counterpart
Polytrichum commune	Hairycap moss	Circumboreal
Sarcococca hookerana var. *humilis*	Sweet box	China
	DECIDUOUS GROUNDCOVERS	
Hosta lancifolia	Narrow-leaved plantain lily	Japan
Hosta plantaginea	Fragrant plantain lily	Japan
Hosta sieboldiana	Plantain lily	Japan
Maianthemum canadense	Canada mayflower	Canada S to IN & W to NY; a Japanese mayflower is *M. dilatatum*.

EVERGREEN GROUNDCOVERS	**COMMON NAME**	**COMMENTS—NATIVITY**
Petasites japonicus	Fuki	Korea, China, Japan; petioles are eaten as a vegetable in Japan
	PERENNIALS	
Anemone x hybrida	Japanese anemone	Japan, China
Arisaema triphyllum	Jack-in-the-pulpit	Many Japanese counterparts
Equisetum hyemale	Horsetail	Eurasia, Pacific N. Amer.
Erythronium americanum	Dogtooth violet	American counterpart to Japan's *E. dens-canis*
Iris cristata	Crested iris	SE U.S.
Iris kaempferi	Japanese iris	Japan; numerous cultivars
Iris pseudacorus	Yellow flag	W. Eur., N. Afr.; naturalized in N. Amer.
Polygonatum biflorum	Solomon's seal	N. Amer.
Polygonatum odoratum	Solomon's seal	Japan
Rodgersia aesculifolia	Bronzeleaf	China
Trillium erectum	Purple trillium	Many Japanese counterparts.
	FERNS	
Adiantum pedatum	Maidenhair fern	N. Amer. & E. Asia
Athyrium felix-femina	Lady fern	Temperate Northern Hemisphere
Athyrium goeringianum	Japanese painted fern	Japan
Dryopteris erythrosorus	Japanese shield fern	China, Japan; *D. marginalis* is an American counterpart
Polypodium virginianum	Rock polypody	E. N. Amer.
Polystichum acrostichoides	Christmas fern	E. N. Amer.
	BAMBOO & ORNAMENTAL GRASSES	
Arundinaria pygmaea	Kenezasa	Japan
Arundinaria variegata		
Arundinaria viridi-striata		
Sasa veitchii	Kumazasa	Japan — popular in gardens.
Sasa palmata		Japan, Sakhalin
Shibataea kumasaca	Okame-zasa	Japan — common in gardens.
Phyllostachys aureosulcata	Yellow groove bamboo	China
Phyllostachys nuda		China
Sinarundinaria nitida	Fountain bamboo	China
Thamnocalamus spathaceus	Umbrella bamboo	China

EVERGREEN GROUNDCOVERS	COMMON NAME	COMMENTS—NATIVITY
Miscanthus sinensis 'Gracillimus' 'Strictus'	Susuki	E. Asia, naturalized in some E. states
Pennisetum alopecuroides	Fountain grass	Asia
	AQUATICS	
Nelumbo nucifera	Lotus	Orient; edible rhizomes & seeds; sacred to Buddhists.
Nymphaea sp.	Water lilies	Use hardy types
	VINES	
Hydrangea anomala subsp. *petiolaris*	Climbing hydrangea	Japan, Taiwan
Parthenocissus tricuspidata	Boston ivy	Central China, Japan
Wisteria floribunda	Japanese wisteria	Japan
	EVERGREEN SHRUBS	
Abelia x grandiflora	Glossy abelia	China; semi-evergreen
Buxus microphylla	Littleleaf box	Japan
Camellia japonica	Camellia, Tsubaki	Japan; S. Korea, Taiwan
Cryptomeria japonica 'Elegans Nana'		A dwarf cultivar of this tree
Ilex crenata 'Helleri'		
Ilex x meserveae		
Ilex pedunculosa	Longstalk holly	Japan
Juniperus spp.	Juniper	Many species & cultivars are appropriate
Kalmia latifolia	Mountain laurel	E. N. Amer.
Leucothoe sp.		*L. fontanesiana* is a SE U.S. native
Mahonia bealei	Leatherleaf mahonia	Confused in cultivation with *M. japonica*, a Chinese species cultivated in Japan.
Photinia glabra	Japanese photinia	Japan
Picea abies 'Nidiformis'	Dwarf Norway spruce	Low with a dense head
Pieris japonica	Japanese pieris	Japan
Pinus strobus 'Nana'	Dwarf white pine	
Rhododendron keiskei		Central Japan
Rhododendron makinoi		Japan
Rhododendron obtusum	Kurume azalea	Japan; numerous cultivars
Rhododendron smirnowii		Caucasus

Evergreen Groundcovers	Common Name	Comments—Nativity
Rhododendron yakusimanum		Japan
Skimmia japonica	Japanese skimmia	Japan
Taxus baccata 'Repandens'	Weeping English yew	
Tsuga canadensis 'Pendula'	Weeping Canada hemlock	
	Deciduous Shrubs	
Acer palmatum var. *dissectum*	Cutleaf maple	Japan ; numerous cultivars
Berberis thunbergii 'Crimson Pygmy'	Dwarf Japanese barberry	Japan
Callicarpa japonica	Japanese beautyberry	Japan, China
Clethra barbinervis	Japanese clethra	Japan; *C. alnifolia* is an American counterpart
Corylopsis pauciflora	Buttercup winterhazel	Japan
Corylus avellana 'Contorta'	Harry Lauder's walking stick	Europe
Cotinus coggygria	Smokebush	S Eur. to Asia
Cotoneaster horizontalis	Rockspray	W. China
Enkianthus perulatus		Japan
Ilex verticillata	Winterberry	N. Amer.
Lespedeza bicolor	Bush clover	Japan
Nandina domestica	Heavenly bamboo	India to E. Asia
Paeonia suffruticosa	Tree peony	China, Bhutan to Tibet; many cultivars
Rhododendron mucronatum	Snow azalea	Japan
Rhododendron schlippenbachii	Royal azalea	Manchuria, Korea, Japan
Viburnum plicatum var. *tomentosum*	Doublefile viburnum	China, Japan
	Deciduous Large Shrubs-Small Trees	
Acer griseum	Paperbark maple	China
Acer palmatum	Japanese maple	Korea, China, Japan
Amelanchier canadensis	Shadblow	Quebec to GA
Cornus kousa	Japanese dogwood	Japan, Korea
Cornus mas	Cornelian dogwood	Eur., W. Asia
Davidia involucrata var. *vilmoriniana*	Dove tree	W. China
Hamamelis mollis	Chinese witchhazel	W. China; American counterpart: *H. virginiana.*
Magnolia stellata	Star magnolia	Japan

EVERGREEN GROUNDCOVERS	**COMMON NAME**	**COMMENTS—NATIVITY**
Magnolia x loebneri 'Merrill'	Loebner magnalia	
Prunus maackii		E. Asia
Prunus mume	Japanese apricat	E Asia
Prunus serrulata	Japanese flowering cherry	E Asia
Prunus subhirtella 'Pendula'	Weeping Higan cherry	Japan
Oxydendrum arboreum	Sourwood	PA to IL, S to FL
Salix matsudana 'Tartuosa'	Carkscrew willow	
Stewartia pseudocamellia	Japanese stewartia	Japan; American counterparts: *S. avata* & *S. malacodendran*
Styrax japonicus	Japanese snowbell	Japan, China; American counterparts: *S. grandifolius* & *S. americanus*
Viburnum sieboldii	Siebold viburnum	Japan

EVERGREEN TREES

Chamaecyparis abtusa	Hinaki false cypress	Japan; numerous cultivars
Cryptomeria japanica	Japanese cedar, Sugi	Japan; numerous cultivars
Ilex opaca	American hally	N. Amer.
Ilex pendunculosa	Langstalk hally	China, Japan
Pinus bungeana	Lace-bark pine	NW China
Pinus densiflora' Umbraculifera'	Tanyosho pine	Japan
Pinus koraiensis	Karean pine	Japan, Korea
Pinus parviflora	Japanese white pine	Japan
Pinus strabus	White pine	N. Amer.; various dwarf cultivars
Pinus sylvestris	Scotch pine	Eurasia
Pinus thunbergiana	Japanese black pine	Japan
Sciadapitys verticillata	Japanese umbrella pine	SW Japan

DECIDUOUS TREES

Acer rubrum	Red maple	U.S.
Cercidiphyllum japanicum	Katsura tree	Japan, China
Ginkga biloba	Maidenhair tree	Frequently seen at temples in Japan
Koelreuteria paniculata	Goldenrain tree	China, Korea, & naturalized in Japan
Metasequoia glyptastroboides	Dawn redwood	China
Nyssa sylvatica	Sourgum, tupela	E. N. Amer.
Prunus yedoensis	Yoshino cherry	In cultivation in Japan; unknawn in the wild.

MOSS GARDENING

Michael B. Trimble

Growing moss ornamentally is not a widely accepted practice in American gardens. Unstinting efforts and considerable sums of money are spent annually to eradicate these diminutive plants. Sadly, we have come to automatically equate the presence of moss with horticultural inadequacy in the garden. Persuading fellow gardeners to reconsider the ornamental potential these plants embody is a challenge.

Mosses, along with lichens, were among the first plants to establish themselves upon the barren rock of the early land masses left in the wake of receding oceans, but their ability to grow where little else will, while worthy of our admiration, has instead earned them a reputaion as weeds. Favoring spots where shade and dampness thwart the growth of grasses and flowering plants, the presence of moss is taken as an indication hat such spots are culturally deficient, urther adding to our tendency to regard hem as undesirable garden inhabitants.

How differently we look upon the mosses in nature that cluster at the bases of trees in a shady woods, or cling tenaciously to the rocky faces of boulders. Frequently mosses and lichens will share a rocky cleft or moist recess among the roots of an old tree, their varied shapes and colors providing a visual feast to the observant. The lush, moist greens, grays and even whites of a moss-strewn stream bank or moist woodland floor evoke an appreciative response—mosses are certainly not weeds! In their native habitats they personify the gentler, more pacific side of our natural surroundings. They contrast with the rugged character of rocky crags and mountain tops, the dignity of mature trees, and blend with the fluid energy of streams and cascades. In their natural settings mosses please the eye without rousing feelings of disdain.

In Japan, nature has been the guide in the creation of both public and private, religious and secular gardens. Replication is rarely the aim; instilling some feeling of the spectacular natural beauty of Japanese islands within the garden is the goal. Mosses' serene character and ability to blend harmoniously with rock, water and plants used in creating a garden have earned them favored status among Japanese gardeners. Looking upon an expanse of moss as it runs in among the roots of trees or up to the rocky edge of a stream or waterfall, one can easily appreciate the ornamental usefulness of these agreeable little plants.

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Moss Botany

Mosses lack true roots and vascular tissues which trees, shrubs and flowering plants possess. Instead they have primitive, rootlike structures called rhizoids which anchor a moss plant to its chosen home, while the task of taking up moisture is shared by nearly all surfaces of a moss that come in contact with water.

Mosses also differ from most garden plants by their reproductive cycle. Taking the hairycap moss, *Polytrichum commune*, as an example, the soft green carpets of small plants we recognize as moss are made up of sexual, or gametophytic representatives of species. Each individual will spawn both male and female gametes. The gametes meet and fuse if the moss is cloaked in sufficient moisture for the male gamete to move from its point of origin to where the female gamete is formed. This assures the development for the alternate, sporophytic generation.

The sporophytic, or asexual generation, is represented by a spore producing capsule normally on a stalk that remains attached to the gametophytic parent. From the spore produced in the capsule, the next gametophytic generation will germinate, which we again recognize as moss. This means of achieving sexual reproduction is surprisingly efficient, belying their apparent vulnerability.

Botanists have identified upwards of 14,000 species of moss, with species adapted to such varied habitats as moist and shady, dry and sunny, soil dwellers, wood dwellers and those that prefer solid rock. Most are easily grown. However, to grow them well one must take the time to match a given species to its desired growing conditions.

Most mosses likely to be used in the garden thrive where soils are moist year round, shade is plentiful during the summer and the soil is acidic. Mosses found growing on wood or stone can be used as well, with best results coming when the mosses and their chosen home are

A bed of moss in a raked dry garden.

Moss growing between the rocks in Nanzenji Garden, Kyoto, Japan.

PHOTO BY ELIZABETH SCHOLTZ

noved together into the garden.

Mosses are tough. They can suspend heir growth processes, entering a state f dormancy, when the conditions of heir environment do not favor contin- ued growth. Severe cold, heat, or drought can all be endured.

If suitable shade and moisture are vailable, mosses can be used in many pots where lawn grasses fail and herba- eous groundcovers can't get established. Mosses are an excellent contrast to both tone and wood and can be used advan- ageously in shady rockeries or to cloak he ground left bare by the greedy roots f shallow rooted shade trees. Their ten- ency to go dormant as their surround- ngs dry can be off-set with an occasional atering. Having no true roots, such wa- terings need not be deep.

Moss lawns are becoming popular where excessive shade thwarts the use of lawn grasses. A close look at your own lawn will probably reveal a wealth of mosses intermingled with the grasses where trees cast their shade.

If hairycaps dominate the mosses already present, steps to acidify the soil may be all that is needed to encourage their dominance of the entire area. Dusting with sulfur to lower the soil's pH to a level of 6.0 or less will usually do the trick. Weeds less finicky about pH must be removed manually.

Simple steps are needed to introduce mosses into a garden. First, be sure the site offers growing conditions that will foster their vigorous growth. Secondly, prepare the site by removing all non-moss growth that might interfere with their later care and appearance. Lichens, ferns and wildflowers all belong to the group of plants I would leave in place while grasses and groundcovers such as pachysandra and ivy should be removed. Mosses do not need fertile soil and its presence often hinders moss by encouraging the growth of weeds. Good moisture retention is desirable and steps to improve a soil's tilth will benefit a moss planting over the long run.

The most straightforward way to bring mosses into the garden is to transplant moss sods. The usual source will be colonies growing wild which will provide the opportunity to observe their growing conditions first hand. Emulating their preference will help assure success in the garden. In Japan, moss sods can be purchased much like turf.

When collecting mosses from the wild take only what is needed and leave as much as possible undisturbed to insure that the native colonies will continue to prosper. Mosses are tough and can re-establish themselves quickly, however, excessive collecting can imperil both the diversity and vitality of native moss colonies, especially those growing in exposed locations.

With the sods in hand and their new home properly prepared, moisten the sod and planting area and set the sod firmly in place. Given ample moisture, the moss' rhizoids will readily anchor the sod and the colony will slowly begin to expand outward. The cool days of spring and autumn are best suited to moss transplanting. In addition, the absence of tall grasses and other herbaceous plants at these times will make it easier to spot the mosses you want.

Mosses can also be introduced by means of spores. However, this is a more labor-intensive method and less reliable as it gives weeds a better chance to move in before the mosses do.

Mosses are also capable of regenerating themselves from bits and pieces dislodged from an actively growing or dormant plant. Gather pieces of moss, dry them and then spread the powdered bits over moist soil. This method has the drawback of leaving the young plants vulnerable to weeds and weather. However, it can be a useful means for getting moss to grow in tight spots where it is difficult to anchor sods.

The care of moss planting involves little more than 1) watering when needed, 2) weeding, and 3) keeping leaves off the moss in winter. In Japan, expanses of moss are swept regularly while the maritime climate can usually be relied upon to keep them well watered.

Recommended Species

The most popular and perhaps the bes moss for covering large areas is th hairycap, *Polytrichum commune.* Its dark green tint and soft, needlelike appear ance offers a most appealing substitut for grass. Its uniform height never need mowing, insects and diseases are n problem and most weeds can be discou aged by acidifying the soil.

The common fern moss, *Thuidium de icatulum* is another splendid addition to moss planting. Its delicate, light gree featherlike form is effective at the base gnarled roots or skirting in among grouping of lichen-encrusted stone. Th greenish-white tufts of the pincushio moss, *Leucobryum glaucum*, are a usef contrast while the windswept appearan of the broom mosses, *Dicranus* spp make fine additions to the garden. Th happy-to-grow-just-about-anywhere co moss, *Funaria hygrometrica*, will readily f in where needed.

The beauty we see in them in the native settings can be transferred in the garden through careful attention garden design and site preparation, wi the gardens of Japan serving as viv examples of how it can be done.

BAMBOOS AND JAPANESE GARDENING

KIM SORVIG

There are bamboos
ten thousand meters high
if you look at their shadows by moonlight.

Su Tung-P'o (1037-1101,
China, Sung dynasty)

Bamboo is a state of mind. To use it effectively in a garden, especially a Japanese garden, it is not enough to know how to grow it. That is in many ways *less* important than having a feel for bamboo's history, evocative power and cultural import. Bamboos have long shadows indeed, for they are the most useful group of plants known to humankind and are as mysterious and mystical as any living thing on earth. Whether cast by the moonlight of intuition or the stark light of scientific study, a sense of these ten-thousand-meter shadows help give bamboo its proper place in a garden.

There are excellent Japanese gardens which lack a single *living* bamboo, but even in the stone garden of Ryoanji, there are elements *crafted* of bamboo. In fact, in Japan and China, bamboo is so much a part of the fabric of life, it seems there would hardly have *been* any Oriental culture to give birth to such gardens, without the influence of the giant grasses.

The Kingdom of Bamboo

Bamboos are a large subfamily of the grasses, woody and often giant. Their natural range centers in Asia, ('bamboo' is a Malay word), but includes Africa and the Americas. They range in size from 100-foot-tall giants to tiny ground-creepers, and grow in habitats from jungle riverbank to the high Himalayas. About 45 genera have been named, making several hundred species.

Mysteries surround the bamboos, and one need not be a botanist to experience this. Very little can equal the radiantly dim light inside a bamboo forest, the subtle colors from waxy white through yellow, green, to purple and black, the

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graceful columnar stems, and the sound of leaves rustling in the air and underfoot. Flexible yet indomitable, it is small wonder that bamboo is one of the three plants (with pine and plum) that symbolize the essential virtues in Japan. Even a small planting has something magnetic about it.

Besides inspiring wonder in lay people, bamboos almost seem to *exist* to confound botanists! These "trees" are actually grasses, their "culms" (stems) hollow and segmented by "nodes" or joints, at which branching occurs. They are woody, but do *not* grow by annual rings. Their evolutionary history remains a conundrum: while their modern center of distribution is Asia, recent studies indicate that their nearest living relatives may be small, non-woody grasses now known mainly in the New World. Ecological jacks-of-all-trades, they adopt almost every kind of survival strategy, as canopy, understory, shrub, ground layer, or even vine; few plant families show such wide adaptability. This great diversity of form is unusual in a group whose reproduction is normally *vegetative;* besides, their chromosomes show *little* variability! As for their flowering, it is a subject for both botanical and mythological research!

Evolutionary relics themselves, the giant pandas have a particular interest in bamboo's flowering, as do gardeners. Many bamboos grow for 30-120 years before ever flowering. Some flower once and die. There have been reports that these cycles are synchronized for every bamboo of a species, even when transplanted continents from "home." *Some* of this is possibly myth; it is definitely not true for all species. Many garden specimens are clones of a single parent, which may explain some cases of synchronous flowering. But the mystery, and the consternation it causes, remains.

For a plant competing in an ecosystem, either fast growth or the strength and height provided by woodiness can help. But it is a rare plant that can do *both:* only very soft tissue can grow fast, but soft stems cannot reach great heights. The bamboos have solved this paradox rather neatly. The solution? A tight "sheath," a leaflike structure which wraps around each growing segment of the culm so tightly that it can *only* grow upwards. And grow they do: some species up to 40 inches a day, fast enough to stand and watch. Once the culm stops growing, becomes woody, and can support itself, the culm-sheath drops away. The side-groove typical of bamboo stems is formed by 'extrusion' as the culm pushes past a branch-bud held tightly in place by the sheath.

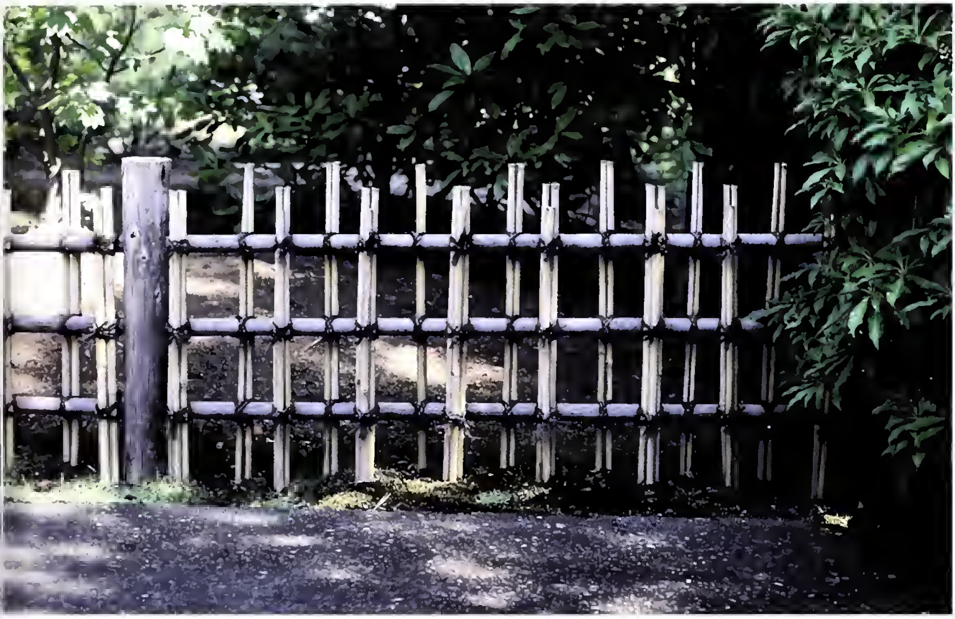
Traditional Garden Uses of Bamboo

The many uses of bamboo in traditional Oriental gardens reflect its ecological diversity. Trees, shrubs, or groundcover bamboo fills may niches, in design as i nature.

The larger bamboos make wonderfu forests, 100 feet tall and covering man acres, with little undergrowth and a open, lively feeling which suggests th interior of Japanese houses. In th largest palace gardens, such forest divide or frame whole landscapes, an form groves through which to wal among the foot-thick jointed stem (culms).

Medium-size bamboos (10-50 feet) ar far more common in U.S. gardens. Thes can form screens or stand alone as fe tured plantings. They are also used a understory with deciduous canopy tree (but not with the larger bamboos). Bein mostly evergreen, they are useful as backdrop and for winter interest. The vertical culms make a striking accen especially effective in tiny courtyards reflected in water.

The small bamboos serve as shru



Bamboo can be used as a construction material, as it is in this hand-tied fence.

bery, groundcover and hedges, often clipped. They too have a variety of textures and are usually evergreen. Small and medium-sized species can be planted as half-hardy perennials in colder zones, and also grown in containers.

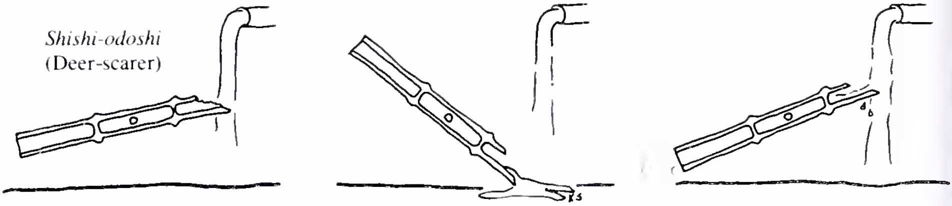
The textural variety of bamboo finds great expression in Japanese gardens. Their form may be upright or arching, with few or many branches, straight or zig-zag; leaf size, shape, density, and color vary; the new sheaths are tufted, finely hairy, ribbed or smooth. There are a number of "abnormal" forms, such as the Tortoise-shell and Buddha's-belly bamboos, in which the internodes swell and contort into fantastic shapes. Almost every color except bright red can be found among bamboos which are sometimes striped or spotted.

Without bamboo as construction material, the gardens of the East would be much impoverished. Fences of whole or split canes, woven or tied or pegged, rip-rails of bent split canes, posts, gates, handles—all are common, in hundreds of designs. Bamboo can be steamed and bent into almost any shape. It is often inserted into plaster walls to frame or divide an opening.

Two very traditional Japanese constructions for the garden are the *tsukubai* water basin, and the *shishi-odoshi* or "deer-scarer." The *tsukubai* may be fed through a bamboo pipe musically dripping water and include a bamboo scoop for drinking or washing. The water scarecrow is always made of bamboo constructed from a large culm, set on a pivot and driven by water. It makes a resonant, eerie booming sound that echoes through the garden.

Cultivating the Bamboo

All bamboos grow from rhizomes; from buds on these grow the culms (also called 'canes,' a term better reserved for dried bamboo). Each culm gains full height and diameter in ONE season, unlike trees. It will harden, still alive, for



1. Bamboo two-and-one half nodes long, on a pivot; the short end fills with water and drops.

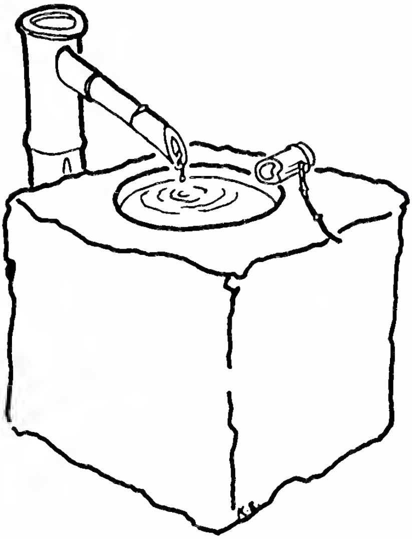
2. Water spills out and the long end is once again heaviest.

3. Long end falls, strikes the ground and resonates. Water refills the short end.

several years, and if not harvested will die standing.

Based on the way their rhizomes spread, bamboos are classed as "clump-forming" or "running," an *extremely important* distinction when selecting them for a site.

CLUMP bamboos tend to form dense, slow-spreading stands with culms close together. Their rhizomes are rather short and stout. Mainly of tropical origin, they shoot when rains follow a dry season, usually in summer or early autumn in the US. Few are frost hardy. *Bambusa* and *Dendrocalamus* are main clump genera grown.



Tsukubai with bamboo plumbing and water scoop or ladle. There are many types of water basins. This one has a hidden faucet connection to allow a constant water source.

RUNNING bamboos tend to have long slender rhizomes, resulting in a more open stand and more invasive habits Represented by *Phyllostachys, Sasa,* and *Arundinaria,* they are native to temperate climates, and therefore sprout in response to spring warmth. They are relatively hardy, and few are happy in year-round warmth.

Two misconceptions about bamboo are common causes of problems: one that they are all heat-loving, and two that they like swampy soils. There ar bamboos hardy to — 20 degrees F, an wind- and sun-scorch strongly affect ha diness. And they will NOT tolerat waterlogging, which suffocates and ro the rhizomes. Excellent drainage is probably more important than plentifu water, though that is usually needed too

Selecting Bamboo Species

AVAILABILITY: Bamboos are usually sold container nursery stock. The America Bamboo Society (ABS) compiles a updated list, at present showing species and 22 suppliers in the USA. Th list is free for a self-addressed stampe envelope. Importing bamboos could bring in grass-family diseases that endanger major cereal crops and is prohibited by quarantine regulations.

On Naming: One problem in obtaining bamboo is the jumble of names by which they are known. Many species have no common name in English. Flowers, on which scientific names are based, have rarely been observed, in some species never, so experts disagree on Latin names. Nurserymen and collectors are understandably confused so everyone adopts some compromise. In this article, the names used in the ABS list are followed for convenience.

Hardiness: In general, the true clump bamboos are injured or killed by 0 degree F, some by 5 degrees; a few can take —10 degrees. The running bamboo will survive between 0 and — 10 degrees on average. Rhizomes may survive much colder winters than culms, and sprout anew each year, as half-hardy plantings.

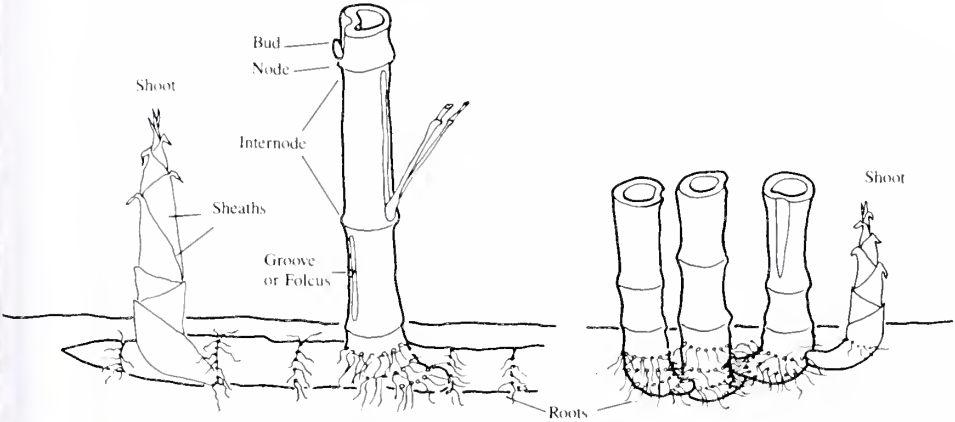
Where hardiness is crucial, *Phyllostachys nuda, P. flexuosa, P. aureosulcata, Sinarundinaria nitida, Pseudosasa japonica* and the *Sasas* are most reliable.

Invaders: These species are particularly invasive and should always be contained unless space is unlimited: *Arundinaria anceps, A. vagans, A. pygmaea, A. variegata, A. viridistriata; Sasas*, especially *S. palmata*; under good conditions *Pseudosasa japonica*; and most *Phyllostachys* given time, though less so than the above.

Substitutes & Imposters: "Sacred-, heavenly-, or Flowering-bamboo," *Nandina domestica*, is a Chinese relative of barberry, not a bamboo. Its foliage is vaguely bamboolike, attractive as a substitute or in its own right.

Many reeds, pampas, grasses, etc. (including *Arundo*, not to be confused with *Arundinaria*) can give bamboolike effects in areas where bamboos cannot grow.

"Mexican Bamboo" is *Polygonum cuspidatum*. This extremely invasive weed should only be considered as a bamboo substitute in very harsh climates; elsewhere it is uncontainable. It does



Running species Underground stems Clump-forming species

All bamboos grow from rhizomes, and from buds on these grow the culms (also called canes) which are jointed above-ground stems. Each culm gains full height and diameter in one season. Pictured above are the two types of bamboos based on the way their rhizomes spread.

Drawings courtesy of the Author

resemble a 3-8 foot bamboo at first glance, but it is related to buckwheat. "Mexican Weeping Bamboo," however, is a true bamboo, *Otatea aztecorum*.

Establishment, Care and Problems

Planting and Routine Care: Select or create a well-drained, moist location, fertile and sheltered from strong wind — the smaller the species, the more shade, as a rule of thumb. Drainage is essential and poor drainage should be improved to the depth of 18-24 inches by adding gravel to subsoil and sand to topsoil. The water table should be at least 18 inches below the surface. High nitrogen fertilizer is beneficial. Build containment structures if needed.

For even stands, bamboos should be spaced at about half their mature height. Refirm the soil. Planting depth should match the old soil mark (there will be a color change on younger culms); usually, this buries the main rhizomes two-four inches. Water until soil is settled (tamping can damage rhizomes). Apply mulch to a depth of two-three inches.

For the first season, watering is critical. The soil should never dry; a thorough one inch water every 5-10 days minimum is needed. Once established, bamboos are quite tough. Little care is needed except yearly fertilization and mulching just before shoots appear and irrigation if climate dictates. Dead culms should be removed or they choke the clump. Pruning all three-year-old culms gives maximum regrowth for most species while taking only four-five year ones promotes fewer but larger culms.

Transplanting Bamboo: The commonest method of propagating bamboo of all species is by divisions transplanted in the spring. Divisions may be taken from the edge of a clump, or the whole clump dug up and split. The smallest division should include two culms (from two years' previous growth), connected by rhizomes and showing a strong new shoot-bud. Usually it is wise to take larger divisions, about a foot square. The fibrous roots may keep a division with dead or missing rhizomes alive for several seasons, but new shoots will not be reproduced.

Bamboo transplants' roots and foliage are *very* vulnerable to drying. The transplanted culms will most likely die within one or two seasons, by which time there will be new culms to carry on. To slow transpiration when dividing, the old culms can be cut back. But opinions vary on whether this should be done or not. Cut-back culms are unsightly and the process deprives new shoots of shade and shelter which can be critical. Pruning a number of whole *branches* seems preferable; antitranspirants might also be justified. Painstaking moisture protection can allow division at any time *except* when new culms are extending rapidly.

Physical Damage: Rhizomes lie near the surface. Cultivating tools, tamping during planting, and careless walking can damage them. Wind whipping older culms can kill or deform soft new shoots. Tying five or six culms together in a "tipi" will prevent snow damage and mulch will increase frost tolerance.

Pests & Diseases: There are few and are mostly confined to hot humid areas. Rust fungus causes leaf spots and if removing diseased leaves is not enough, fungicides may be used.

Scale insects are common but only unsightly on California and Florida bamboos: they can be removed with soap or oil spray. Mealybug can be removed by water pressure. Ants usually 'herd' these insects, and may require control.

Squirrels and rabbits can be serious pests when their populations are large and hungry, as they eat bamboo shoots. The hard culms are not palatable to these animals, so temporary protection of soft shoots is practicable.

Bamboo "trees" are actually grasses. The larger bamboos make wonderful forests 100 feet tall, with little undergrowth and an open feeling which suggests the interior of Japanese houses.

Photo by Elizabeth Scholz

Lawn chemicals near bamboos should be watched with great care since as grasses, bamboos react differently to poisons than broad-leaf plants. Bamboos are vigorous enough to out-compete most weeds anyhow.

Flowering: This remains a vexed question for bamboo growers. Many species flower on a few culms each year and even those that flower and die will probably grow back from rhizomes or from seed. If prize specimens start to flower, some gardeners try heavy watering, large doses of nitrogen fertilizer and pruning the flowering branches. This may or may not help and should only be tried if flowering is noticed.

Containment & Eradication: The nost effective method of controlling nvasive species is to put a solid curb round the planting. This should be 24-0 inches deep, extending an inch above oil. It can be made of concrete poured directly into a narrow trench of sheet metal, thick plastic lining or other material so long as all joints are lapped, tightly joined and sealed. Escape is likely through any hole 1/4 inch or larger!

Mowing or hand removal of all unwanted new shoots will contain bamboo with barriers, but requires vigilance. Trenching (or for dwarf species slicing with a spade) all around the stand may be effective if done annually. Don't forget the neighbor's yard — gardener and bamboo alike can get a very bad name! Bamboo rhizomes are unlikely to damage walks or foundations as they usually change directions first. If bamboo must be completely removed, dig it out or cut it down; remove any new shoots by hand by mowing or plowing.

Far from being rooted out, however, bamboos are useful, magical plants which can add to any garden, Japanese or not.

SPECIAL PURPOSE BAMBOOS

HEDGES: Most bamboos can be used for hedges and windbreaks. *Bambusa glaucescens* (a.k.a. *B. multiplex*) is called Hedge Bamboo; for clipped hedges it and *Shibataea kumasaca* are two of the best. *Sasa tesselata, S. palmata,* and *Arundinaria anceps* (all strictly contained), *A. simonii, Semiarundinaria fastuosa, Pseudosasa japonica, Sinarundinaria nitida, Thamnocalamus spathaceus,* and smaller *Physllostachys* such as *P. nigra* are also good choices.

For hedge use, choose a species whose mature height exceeds the desired hedge height by 25%. Plant closely (about one quarter the expected height). Running species must be contained in a trench, and their runners aligned with its length. Allow the planting to gain mature height (usually 3 years) before beginning to clip once or twice yearly. Thin older culms evenly and regularly.

CONTAINER PLANTING: The Japanese, rather than fight climate, make excellent use of indoor/outdoor container plants, changed seasonally. In addition to tender bamboos such as *Bambusa glaucescens, Arundinaria falconeri, A. aristata, A. hookeriana,* and *Sinobambusa tootsik*, several hardy species thrive in tubs, showing off their decorative culms. Among these are any *Chimonobambusa*, including the marbled *C. marmorea* and square-stemmed *C. quadrangularis; Phyllostachys aurea* with its swollen nodes, and *P. nigra*'s dark stems. *Pseudosasa japonica, Sinarundinaria nitida,* and *Thamnocalamus spathaceus* are also attractive.

Potted bamboos must have coarse, well-drained soil, and regular feeding and watering. Liquid fertilizer twice weekly is needed during shooting; the soil must neither dry nor be sodden; and humidity should be moderate, avoiding drafts. Bamboos like generous root space, but seem to regulate their own growth before becoming potbound; if repotting, root-prune at the base of the ball to avoid lifting in the pot. Night temperatures should be dropped to 45-50 degrees F in winter for temperate species, which do not thrive in year-round heat; tropical species require minimum temperatures 10-20 degrees higher.

CANES: In an Oriental garden, bamboo timber is indispensable. It is simple to manage an ornamental planting to serve this second purpose. Some of the best species are *Arundinaria amabilis* (Tonkin cane), *A. anceps, A. simonii, Bambusa glaucescens, B. oldhamii, B. tulda, Phyllostachys bambusoides, P. meyeri, P. nigra, P. aurea, Pseudosasa japonica, Sinarundinaria nitida,* and *Chimonobambusa falcata*. Potassium and phosphorus fertilizer can increase strength.

The planting should be allowed to grow uncut for 3 years. For sustainable harvest, one year's growth must equal one year's cut; mark the new culms each year with paint. Harvest with a hacksaw when the culms start to turn yellowish tan. Cure in a dry, shady, ventilated place for 3-12 months; support to avoid warp, and turn periodically.

Properly cured, canes resist rot for 10 years. Lashing is best for joining them; pegs, nails, and bolts will work with pre-drilled holes. To split canes, use a sharp knife and even pressure from the *top*; a rod run through the membranes inside the nodes makes bamboo pipe. A node with one branch attached makes a water-scoop for the *tsukubai*.

SHOOTS: Western gardens are intimately connected with food, and a Japanese garden need not be a museum piece. Many ornamental bamboos provide that delicacy of Oriental cuisine, the edible shoot. *Phyllostachys dulcis, P. nidularia, P. mitis,* and *P. bambusoides* are among the sweetest; many others can be used if boiled in two waters.

To ensure sustained yield, the Japanese use this system, which also gives an annual harvest of canes: establish the planting for 3 years, or until mature-size culms are being produced. Mark *and count* the first set of full-size culms. Next Spring **LEAVE** that number of shoots to grow into culms, marking them with a new color, and harvest all other shoots to eat. Repeat every year, and as each group of marked culms reaches 5 years of age, harvest them in Fall for canes.

FOR FURTHER INFORMATION AND BAMBOO SOURCES CONTACT:
The American Bamboo Society
1101 San Leon Court • Solana Beach, CA. 92075 • (714) 481-9869

THE JAPANESE GARDEN OF THE BROOKLYN BOTANIC GARDEN

This garden in Brooklyn is a traditional Japanese landscape garden, designed and constructed in 1914-1915 by Mr. Takeo Shiota. It was his ambition to make the most beautiful garden in the world. By 1915 he had designed and constructed eight gardens in the vicinity of New York, and his crowning achievement was the one in Brooklyn. All lovers of beauty are indebted to this talented artist who came from Japan in 1907 and lived in New York until his death in 1946.

This garden centers upon a small lake, the outlines of which describe the strokes of the Chinese character *shin*, meaning 'heart' or 'mind.' The lake is fed by a cascade of waterfalls. A small turtle-shaped island is reached by a Drum Bridge. A roofed Waiting Pavilion faces the lake, and hanging out over the water is a modified Tea House with adjacent open pavilion.

In the largest section of the lake stands a *torii* or 'gateway to heaven.' The Shrine on the hill beyond is dedicated to Inari, the Shinto God of Harvest.

There is a tall pedestal-type stone lantern near the waterfall and a low, broad-roofed 'snow-viewing' lantern on the island.

The principal plants of Japanese origin that are included in this garden are Japanese maples, flowering cherries, azaleas, barberry and flowering quince. Restrained use is made of Japanese irises in small clumps around the lake. Flowering plants are used with restraint. ❦

Brooklyn Botanic Garden's own Hill-and-Pond Garden, shown here garbed in the colors of autumn, changes with the seasons.

The torii is modeled after the famous camphorwood one in Miyajima, which stands in the sea.

THE CHALLENGE OF BUILDING A JAPANESE GARDEN IN THE UNITED STATES

KOICHI KAWANA

Sansho-En, Chicago Botanic Garden's promenade-style garden on three islands, was designed by the author.

PHOTO BY KRIS JARANTOSKI

In the period following the end of World War II, many "Japanese gardens" were built in the United States. However, most of them tended to be merely an assemblage of typically Japanese features derived from books on Japanese gardens or copied from photographs of features in such gardens.

No garden should be constructed in a foreign environment without being closely related to its surroundings. The degree of authenticity of a Japanese garden depends, for the most part, on the creativity and the statement of the designer, as the basic principles of such a garden are assimilated to the unique lo-

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KOICHI KAWANA, M.F.A., PH.D., *a native of Japan, is Principal Architectural Associate and lecturer in Japanese art, architecture and landscape design at the University of California, Los Angeles. He is also a partner of Environmental Design Association and has designed gardens throughout the U.S.*

cal environment. This is a major challenge since the garden must be designed with local climatic and topographical limitations in mind.

According to the *Sakuteiki*, the earliest known Japanese garden manual compiled in the 11th century, a particular topography suggests or demands a certain kind of garden design and the designer should respond to it. The subordination of man relative to nature is a time-honored design concept in Japan.

Fortunately, I have had the opportunity to design Japanese gardens throughout the United States including ones in St. Louis, Chicago, Denver and Los Angeles. Most of these cities experience extreme seasonal variations in temperature and many trees and plants commonly used in gardens in Japan will not survive. For this reason, I worked closely with staff members of those gardens to search for plants which grow well in these climates and, at the same time, possess the shape and texture to recommend their use as substitutes for plants found in Japan.

Japanese black pines (*Pinus thunbergiana*) are featured trees in gardens in Japan and in that country, beautifully shaped pines have been readily available. But climatic conditions in some of the cities of the United States make it necessary to substitute Scotch, Austrian (*P. sylvestris, P. nigra*) or other pines. Bushy, untrained pines with the potential for training must be found. They must be trained to take on beautiful forms. Imagination, skill and patience are required. Difficulties are found with other plants which are typical for gardens in Japan such as camellias, azaleas, threadleaf Japanese maples, bamboo and moss, and substitutes must often be found for them as well.

The search for and selection of rocks and their proper arrangement poses another major challenge for the garden builder. The arranged rocks are the skeleton of the Japanese garden. In Japan, the designer can select stones ideal in shape and color at a stoneyard even though the cost may be substantial, but in the U.S. finding appropriate rocks and arranging for their transportation is difficult. It is often necessary to utilize poorly shaped stones to develop a stone arrangement.

Since the stone arrangement is the major structure in a Japanese garden, the designer in Japan may spend hours to set one stone or to change an arrangement found to be inappropriate. In the U.S. the contractor, conscious of the cost of time and labor, depends upon the designer to make a swift decision as to which is the top or bottom and front or back of the stone as it is lifted by a crane and hangs in the air. Once it is positioned, it is difficult to change it. Thus, in the United States, those involved in stone arrangements need additional skill and training to achieve the desired goals.

For a Western type landscape the designer creates a design and provides the landscape contractor with a blueprint. The latter installs trees and stones according to the drawings and specifications furnished. In building a Japanese garden, however, the blueprint serves only as a general guide and is useless unless the garden is constructed by the designer himself or by a garden technician who is familiar with Japanese installations. Otherwise the design may be excellent but the end product may be a disaster.

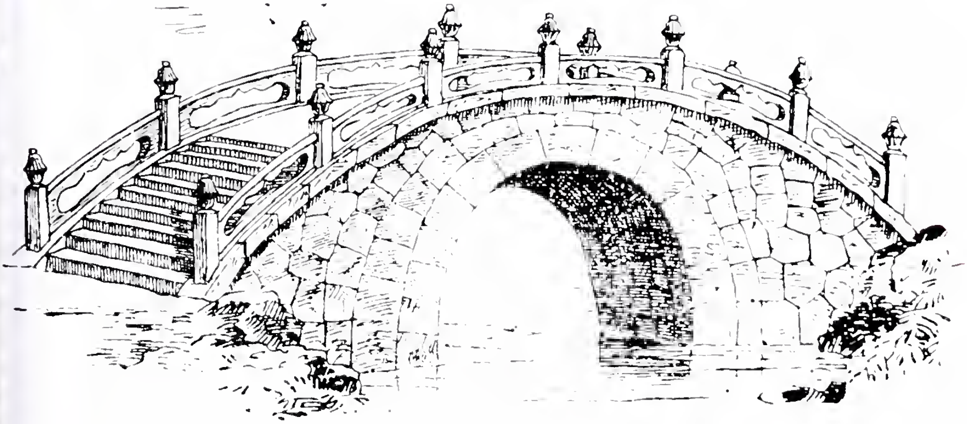
The arrangement of stones and feature trees can be compared to the creation of a sculpture especially when form, size and line movement are considered. In Japan, the designer or architec will either personally supervise the insta lation or delegate it to the *Niwashi* or garden technicians who specialize in ston arrangements and plantings in such ga dens. In the United States, the designer of a Japanese garden needs to be an installer and should also possess expertise on the trimming and training of feature trees.

Another challenge to the builder of Japanese gardens in the U.S. is the difficulty encountered in meeting the requirements posed by local building codes. Such codes affect the building of the foundations of arbors and other garden structures, the materials and construction of teahouses and bridges and the treatment of the edges of lakes. These structures must be authentic in appearance, but many of the structural elements require the closest collaboration with engineers in order to pass the required government inspections.

The use of building materials such as bamboo, cedar bark and black rope poses another challenge. In Japan, materials of this type are replaced every several years. In the United States their use would be limited, durable substitutes should be found or, ideally, proper maintenance and cyclic replacement should be insured.

The element of time plays an important role in a Japanese garden. After Zen Buddhism became popular in Japan during the 13th to the 15th centuries, Zen esthetics such as *wabi, sabi, shibui, yugen* and *koko* which can be translated as "profound and refined elegance with the quality of aged maturity," became essential values for a Japanese garden. Such values can be achieved only by the passage of time accompanied by caring maintenance. For this reason the designing and building of a Japanese garden are only the beginning. To achieve maximum potential, the garden will require time and meticulous care. In this respect I have been called on to instruct the garden staff in maintenance procedures during the construction phase of many gardens and to make periodic visits to those gardens previously built in order to oversee their maintenance and development efforts.

It is ironic that, due to Westernization and funding problems, many of the difficulties which have faced those developing Japanese gardens in the U.S. now beset Japanese gardens in Japan. ❦



THE JAPANESE GARDEN

AT THE DAWES ARBORETUM NEWARK, OHIO

ALAN D. COOK

Some visitors to the Japanese Garden at the Dawes Arboretum are disappointed because of "plainness". Others are delighted, for the same reason. They see a garden designed to instill tranquility yet blend smoothly with the open fields and rolling hills of central Ohio.

The garden was designed and constructed by Makoto Nakamura, Lecturer in Landscape Architecture, University of Kyoto, Japan, during a cultural exchange visit in 1964.

Mr. Nakamura conceived the garden "as an experiment in the exchange of two cultures — American and Japanese." He points out that it can hardly be called an "authentic" Japanese garden because it is constructed of American materials by local craftsmen to suit American conditions. On the other hand it presents the basic idea of Japanese design which is to create landscapes suggested by natural scenery. In Mr. Nakamura's words, "In the Japanese garden these are abstracted from real landscapes, but they are easily recognizable."

This garden is composed of two parts. One enters a lower-level where there are several earth mounds capped by rugged boulders, and a "dry run" bordered with rocks. Mr. Nakamura writes, "the motif here is a forceful landscape of America." This composition suggests craggy mountains and a boulder-lined torrent. The plantings here consist chiefly of a windbreak of pine and spruce which makes a background for flowering cherries.

Next, one comes into the upper o main portion of the garden which is a water-dominated landscape with severa typical Japanese garden elements: pebbl beach, shoreline rock and boulder compositions, islands with connectin bridges, and a natural spring. The pat leads to these major points of interes and conducts the visitor to the Meditation House located in an ideal spot fo resting and enjoying the garden.

Plantings in this area include severa shrubs native to Japan and used i Japanese gardens such as the Japanes

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ALAN D. COOK, *Director of Extended Services, The Dawes Arboretum, Newark, OH, has been guest editor of four Brooklyn Botanic Garden Handbooks and contributor to several others.*

The Dawes Arboretum Japanese Garden photographed in winter.

PHOTO BY ALAN D. COOK

yew (*Taxus cuspidata*), kerria (*Kerria japonica*), flowering quince (*Chaenomeles speciosa*), Japanese maple (*Acer palmatum* varieties). The climate of The Dawes Arboretum is more severe than that of central and southern Japan where the most important gardens occur. Many substitutions of hardy American and European plants were made including rhododendrons (*Rhododendron catawbiense* and *R. carolinianum*), Scotch pine (*Pinus sylvestris*), dwarf Norway spruce (*Picea abies* varieties) flowering dogwood (*Cornus florida*), Canada hemlock (*Tsuga canadensis*).

In the Japanese garden one may miss the massed color from flower and shrub beds characteristic of American and European gardens. But its purpose is to create an atmosphere of calm serenity, encouraging one to stop for rest and for contemplation. It is a haven of peace, removed as far as possible from the confusion of the workaday world.

In judging the work of Mr. Nakamura one should bear in mind not only the fundamental ideal of this kind of garden, but also several peculiar circumstances not usually associated with garden building. First, the setting is among a grove of trees set out as forest test plots, and the lake is designed primarily as a flood control reservoir. Neither of these major elements relate to a Japanese garden, but both are incorporated successfully into the design. Second, the 400-some large boulders which form a conspicuous part of the decoration were gathered from all parts of Licking County, transported to the site and placed by crane. Third, the construction of the Meditation House and the bridges called for skilled craftsmanship in wood and foreign techniques, but here again Mr. Nakamura found local men could accomplish the purpose under his patient direction.

"Thus this garden was built through the experimental efforts of so many people, using mostly indigenous American materials," Mr. Nakamura writes. And he adds, "If the visitor, sitting quietly in the Meditation House feels a peculiar fantasy in the environment, then he will become another part of the experiment."

PINE BREEZE VILLA SHŌFŪ-SŌ

THE JAPANESE HOUSE AND GARDEN FAIRMOUNT PARK, PHILADELPHIA, PA

MARY I. WATANABE

At Pine Breeze Villa, a 16th to 17th century-style Japanese house and garden form a serene yet elegant entity, in a location which is both harmonious and historic. Aesthetically, the villa benefits from the slopes and expanses, the magnificent large old trees and other plantings of the surrounding areas of Fairmount Park. Historically, the site is important in the development of Japanese architecture and landscape design in America. This section of Fairmount Park has had Japanese landscaping and a Japanese structure almost continuously since the last quarter of the 19th century. During the 1876 Centennial Exposition in Philadelphia, the Japanese bazaar was across the street from the current site. The garden, associated with the bazaar, was probably the first Japanese garden in America. From 1905 until a fire in 1955, a 300-year old Japanese temple gate originally exhibited at the 1904 Louisiana Purchase Exposition in St. Louis stood there. Shofu-so has been at the site since 1958.

The *shoin-zukuri* (deck-style construction) house, with an adjoining teahouse for the formal tea ceremony, was designed by the contemporary Japanese architect, Junzo Yoshimura. It was exhibited at the Museum of Modern Art, New York, in 1954-55, and subsequently given to the City of Philadelphia. The garden appropriate to the house and terrain was designed by Tansai Sano.

Under the direction of architect George Shimamoto, the house underwent extensive repairs in 1976, made possible by a Bicentennial gift from the government the Japanese governmen and people. Later, rejuvenation of the garden began, supervised by landscape architect Masao Kinoshita. Although repairs, replacements and additions o plants, and other changes have occurred Sano's design for the traditional landscape garden remains: the intimate relationship between house and garden

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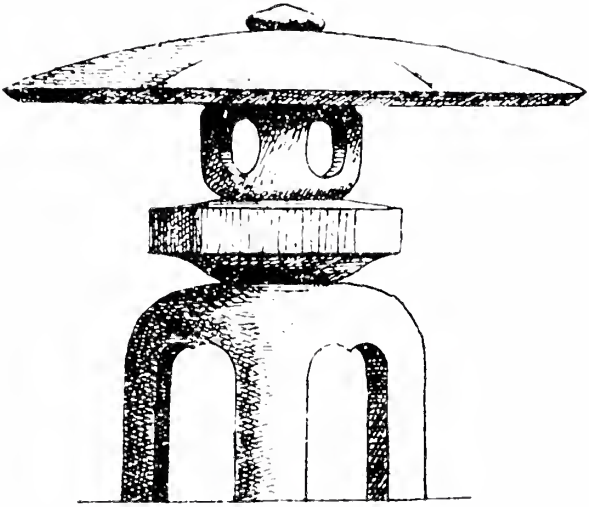


is evident; the layout and landscaping create, in a limited space, the effects of depth and scale; the small hills, rocks, water and trees recall the mountains, streams, lakes and forests of Japan; and the garden integrates the house with its Fairmount Park setting.

The villa occupies about one acre, almost half of which is the pond of the main garden. A solid, white plaster wall with dark, Japanese tile coping, encloses the northern and western sides of the compound. The other boundaries behind the pond are open, permitting views which borrow from the outside scenery and landscaping of Fairmount Park.

The main entry to the villa is through a pair of wooden gates set in the northern section of the wall. There is also a special entrance on the south side for the teahouse and its garden. The grounds are landscaped on all sides of the house, but it is the southeastern view from the house that provides many of the elements of a 16th-17th century garden of a private residence in Japan: a large pond with an island; a stream coming from the rear of the house; mounds constructed to resemble hills; a waterfall; and carefully placed large rocks. The pond at Shofu-so contains *koi* (carp); the island, reached by a low wooden bridge, features a shaped pine (*Pinus sylvestris*); stone lanterns and stone water basins are placed at appropriate spots of the villa.

At Shofu-so, azaleas of many colors, rhododendrons, flowering cherries and other fruit trees, magnolias and tree peonies are the major blooming plants. Maples, pines, cryptomeria, chamaecyparis, bamboo, andromeda, yews, a weeping mulberry, a corkscrew willow, as well as holly, barberry, bayberry, euonymus, are other plants at the villa serve to provide a predominantly green garden. Except for grass in the back garden and on the mounds, the major groundcover is pachysandra.

The garden of Pine Breeze Villa is one to be enjoyed from the verandas and the rooms, but stepping stones permit strolling through various sections of the garden. ❦

SANSHO-EN

THE GARDEN OF THREE ISLANDS

KRIS S. JARANTOSKI

Chicago Botanic Garden's Sansho-En, is a promenade style garden, which invites visitors to meander along winding paths and slowly discover the beauty of its 17 acres. The unique garden plan featuring three islands was designed by Dr. Koichi Kawana and was dedicated in 1982.

The large northernmost island, Horai-jima (Island of Everlasting Happiness), is a rolling, sparsely planted landscape inaccessible to visitors—to be viewed from a distance. On cold autumn mornings mist shrouds it. The middle island, Seifuto (Island of Clear, Pure Breeze),

KRIS S. JARANTOSKI, *Assistant Director of the Chicago Botanic Garden, worked closely with K. Kawana on the development of Sansho-En and currently oversees the maintenance of the garden..*

Chicago's Sansho-En — Two of the islands are accessible by bridge. One is to be viewed from afar.

PHOTOS BY KRIS JARANTOSKI

The Shoin building is cantilevered over the water. Here it is shrouded in fog.

contains a rustic arbor. Nearby water trickles into a basin next to an *oribe* lantern. All this is hidden behind a small pine forest in the *miegakure* or "seen and hidden" style. A boat landing (*funatsuki-ishi*) is composed of two large slabs of granite. Keiunto (Island of the Auspicious Cloud) is the southernmost, largest and highest of the three islands. There, the umbrella arbor, offers visitors a chance to relax on porcelain stools of Chinese style. The adjacent dry garden contains bush clover, hydrangea and boxwood and is defined by a mixed hedge of holly, privet and flowering quince. The Shoin building, designed after the summer home of a Japanese feudal lord and nestled in an inlet on Keiunto, is the focal point of Sansho-en. The lush moss garden adjacent to it with water basin, *yukimi* lantern, and hostas, is surrounded by an arborvitae hedge.

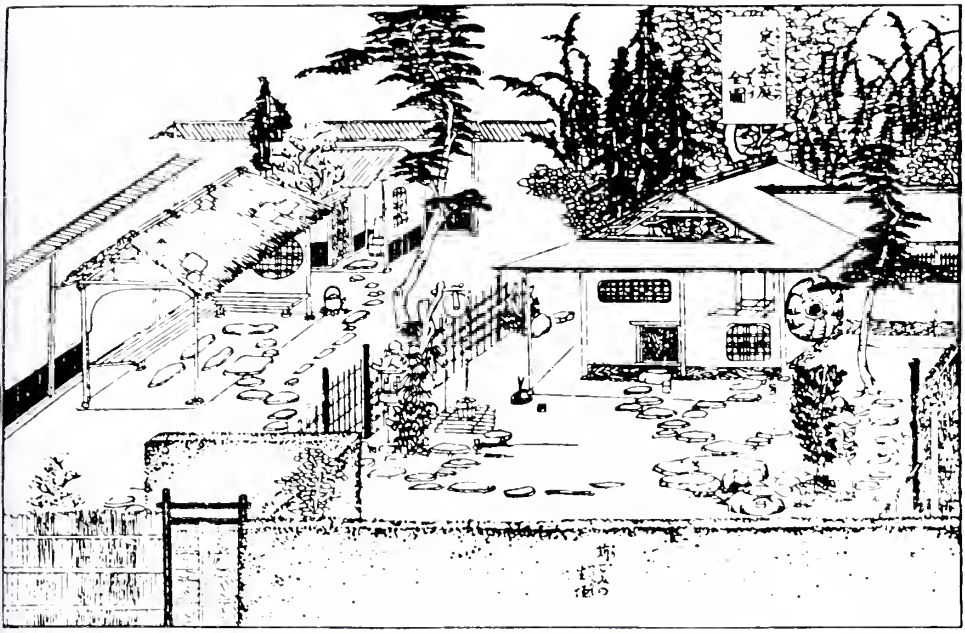
Sansho-En's subtle, refined elegance is softly punctuated by seasonal changes. Rolling hills of pink azaleas, cherry and plum trees, forsythia and crabapples announce the arrival of spring. Flowers of eulalia grass (*Miscanthus*) and bush clover (*Lespedeza*) along with ripening persimmons and the blazing foliage of maples, euonymus and viburnum foretell the coming of winter in the continuous rhythm of nature. Pines, yews and boxwood soften the Chicago winter and enhance the frequent snowfalls.

Sansho-En is a compilation of many styles of Japanese garden design which stirs the imagination, integrates people and nature, restores the heart and brings peace to the soul. ❦

THE JOHN P. HUMES
JAPANESE STROLL GARDEN
MILL NECK, NY

STEPHEN A. MORRELL

A hill garden



A tea garden

The John P. Humes Stroll Garden was created by a Japanese landscape designer and his wife in 1960-62. In 1983 the garden was donated to the adjoining North Shore Wildlife Sanctuary.

In keeping with the Japanese reverence for nature, the garden harmoniously blends the contrived and the natural. Using the existing topography to suggest the garden design, the sloping and forest land was transformed into an idealized landscape of mountains, streams and ocean. Gravel paths mimic mountain streams and form areas to pause. The path leads to the pond at the base of the hill. Vistas reveal themselves in sequence.

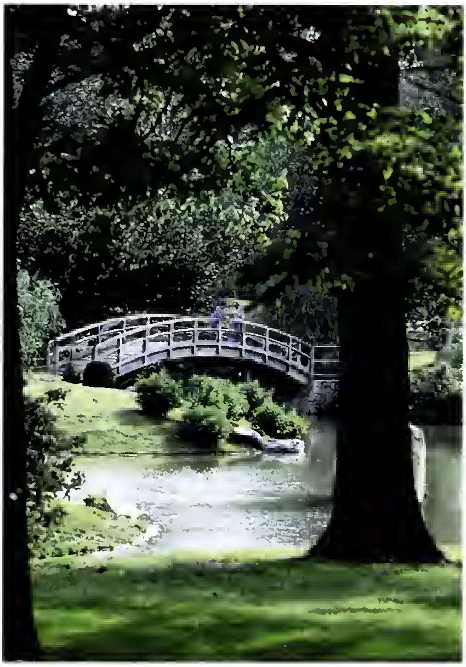
The design centers around a teahouse which offers a quiet retreat. Its garden provides a tranquil atmosphere using mostly evergreen plants, ferns and moss.

Plants in the outer stroll garden are a blending of existing native flora and indigenous Japanese plants, and reflect the changes in season so revered by the Japanese. With early spring come the delicate hues of cherry blossoms, followed by azaleas. Early summer brings a display of Japanese iris. During autumn, both native and Japanese maples turn brilliant reds, oranges and yellows. Winter snow highlights the outlines of trees and lantern tops and makes designs on fences. ❦

SEIWA-EN

MISSOURI BOTANICAL GARDEN

ALAN P. GODLEWSKI



Drum bridge in Seiwa-en.

Seiwa-en, meaning "garden of pure, clear harmony and peace," occupies over 14 acres making it one of the largest Japanese gardens in North America. The garden is the result of a masterful design by Professor Koichi Kawana. The basic style of the garden is "strolling" garden (*chisen-kaiyushiki*). Gardens of this style have a lake as their main feature and were popular among Japanese feudal lords of the 17th and 18th centuries. The other facet of their design is extensive lawn areas which relate an expansive feeling.

The 4 1/2 acre lake in Seiwa-en is irregular in its configuration, which permits vistas from divergent locations around the perimeter. A series of panoramas are revealed including four islands.

ALAN P. GODLEWSKI *was Chairman of the Department of Horticulture at Missouri Botanic Garden in St. Louis.*

Tortoise Island and Crane Island are auspicious symbols of immortality and happiness, Paradise Island is a three-rock arrangement projecting from the water near Crane Island. This island celebrates happiness and immortality, and is the spiritual center of the garden.

The fourth island, called *Nakajima* or Middle Island, is accessible by two foot bridges. When *taikobashi* or drum bridge, is reflected in the lake's surface, it outlines a circle. The second bridge, a *dobashi*, or earthen bridge, is a low bridge constructed over a timber framework which is edged in mondo grass. The Middle Island also houses the teahouse, a structure which was built in Japan and given by Missouri's sister state Nagano Prefecture.

Several styles of stone lanterns are also used in the garden including the snow-viewing lanterns, or *yukimi-doro*. Two are preserved from the Japanese Imperial Exhibit at the 1904 World's Fair and another is a gift of Suwa City, Japan, the sister city to St. Louis. Another lantern projects out over the water with a slender arching stone base.

Seiwa-en is composed of plantings both native to Japan and Missouri. The framework of the garden is large oaks, cypress and black tupelo. Other plants are Japanese black pine, Kwanzan cherry, Japanese maple, star magnolia, and Japanese holly. These plantings are subtle arrangements of texture and color which are highlighted by seasonal display: spring is announced with weeping cherries, peonies and azaleas; summer with Japanese iris and lotus; fall by the brilliant colors of the oak, hickory, black tupelo and chrysanthemums; and winter is delineated by snow held upon the branches of the trained trees and the snow-viewing lanterns. This Japanese garden is a garden for all seasons. ❦

Zig-zag bridge (yatsuhashi).

PHOTOS: MISSOURI BOTANICAL GARDEN

Armistead Browning and William Frederick traveled together and studied Japanese gardens in the Kyoto area for two weeks in 1981. Because of their similar exposure to Japanese gardens but their different landscape design philosophies, we posed this question to each as practicing landscape designers in America: "What can we learn from Japanese gardens?"

Both have several answers to that question. — *The Editors*

LESSONS FOR AMERICANS TO LEARN FROM JAPANESE GARDEN DESIGNERS

PART I

WILLIAM H. FREDERICK, JR.

The current trend toward lifting elements of an authentic Japanese garden and placing them in our alien setting offends my sense of appropriateness. To create and appreciate a Japanese garden one must have grown up in Japan, known the famous Japanese landscapes that have inspired these gardens, been part of a religious tradition that is highly disciplined, contemplative and ascetic, and been part of a society where much communication is by symbol. Can you imagine the average American pausing to contemplate the view from each stepping stone in his garden? I can't. On the other hand, I'm always delighted when a client goes to Japan to study their gardens — there is much to be learned.

The Yen for Japanese Gardens

I've tried to figure out why Americans want Japanese gardens and have come up with two possible reasons:

1. There is the notion they are low maintenance both because inanimate materials such as rocks and sand are major elements and because plants are relatively unimportant to the composi

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tion. This is a misconception. Sand must be raked after every rain and kept free from leaves and litter, and plants are important. Moss, often a major element, requires time-consuming effort to get it to thrive. Shrubs must be trimmed to conform to previously established mounded shapes and sizes. Trees must be trained into a particular shape (one of several important styles) and kept in that form. Remember, those Japanese gardens one sees in photographs for the most part belong to either the Imperial Family which has the wherewithal to employ professional gardeners of the highest skills or religious orders whose members have an abundance of time and dedication.

2. There is a feeling of peacefulness and strength in the photographs of the better gardens. (Not all Japanese gardens are great works of art.) This has an understandable appeal to Americans leading pressured and harassed lives. To me, if this is what is wanted from the garden, one should analyze how to produce these sensations in a manner that is appropriate for our times in our locale.

I'm also not convinced that "peacefulness" is the total answer to the modern American's needs, at least not the majority. Strong design as a framework is essential and in the case of the majority, this should be fleshed out with exuberance rather than asceticism.

Important Lessons

The Japanese have probably spent more time than any other nationality thinking about and developing a gardening tradition. Some of the important things to be learned from them are:

1. THE ARCHITECTURE AND THE LANDSCAPE ARCHITECTURE ARE DESIGNED AS A UNIFIED WHOLE. Every important room of the palace, temple or house is intimately associated with the garden.

2. THE PERSONALITY OF THE SITE AND COMMUNITY HAS A STRONG INFLUENCE ON THE TOTAL DESIGN INCLUDING THE SITING OF THE ARCHITECTURE, THE DEVELOPMENT OF GARDEN EXPERIENCES, AND THE TRADITIONAL "BORROWING OF SCENERY." Much of our own site development involves insensitive destruction of trees, rocks, interesting contours on the premise that it is more economic to "clear and level" with "new planting" to follow.

3. AESTHETICS ARE A PRIME CONSIDERATION IN THE PLAN FOR THE ARCHITECTURE AND LANDSCAPE. This is accomplished by:

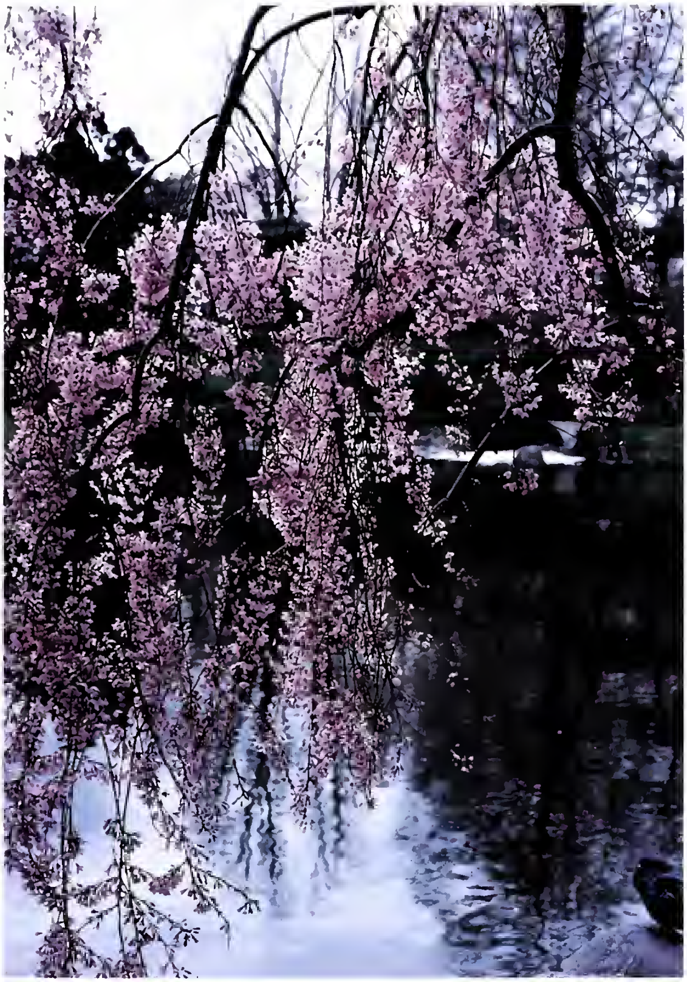
- blocking out distracting views
- creating the feeling of more space than there really is by manipulating scale
- limiting the number of materials involved
- making some open spaces (water, sand, lawn, pebbles, groundcover) have strong design forms
- reducing the complexity of the design to minimal abstractions (Reductivism)
- displaying a sensitivity to "occult balance"

Occult balance is another name for harmonious asymmetry (as opposed to bilateral symmetry). An understanding of occult balance in particular has important application in providing strength to the informal designs which often seem most appropriate to our contemporary life style. Such an understanding is not a mysterious gift of the talented few but simply a matter of training one's eye. Walter Beck (the creator of the American "Chinese Cup Garden" at Innisfree) engaged his guests in an after dinner diversion to sharpen their perception of occult balance. Three objects (such as three pebbles or a salt shaker, ashtray, and cigarette box) were placed on a cof-

Japanese gardens provide a series of experiences. This one is provided by water, gravel, rock and blooming iris.

fee table. Each guest, in turn, arranged them in a manner which brought them into a state of repose with each other (from his or her viewpoint). The remaining guests then expressed their feelings of gratification or dissatisfaction and were expected to explain why. We all do this more or less unconsciously as we react to composition in painting and sculpture, choreography in ballet, and the massing of forms in contemporary architecture.

4. FINALLY, THE JAPANES "STROLL GARDEN" WITH A CLEARL DEFINED CIRCULATORY PATH ILLUSTRATES HOW TO LEAD ON THROUGH A SERIES OF GARDEN EXPERIENCES AND MAKE MAXIMU USE OF THE SPACE AVAILABLE. I some of the best English gardens, such Hidcote and Sissinghurst, one is "direc ed" through a sequence of garden room providing separate and distinct exper ences with sculpture, water and colo



The blossoms of the weeping cherry are repeated in the reflective water of the pond. PHOTO BY BETSY KISSAM

and textural changes. Even in suburban America we are not without the experience of "walking around the yard" after supper. Because much of contemporary American garden design starts with a functional basis (car arrival area, entrance garden, outdoor living area, swimming pool garden, kitchen garden), we have the opportunity for a series of distinctly different, refreshing experiences and the Japanese tradition of the stroll garden has much to teach us about unifying these parts into a strong whole.

To see positive examples of these teachings in contemporary gardens:

- Look at the work of Ed Bye for indoor/outdoor relationships and reductivism applied to elements in the natural landscape producing moods of peacefulness and strength.[1, 2]
- Look at James Rose's house-garden relationships where the house becomes a series of garden pavil-

ions and the merging of indoors and outdoors is nearly imperceptible.[1,3]

- Look at Thomas Church's gardens where the personality of the site and the owners is the design basis and reductivism and strong design forms are paramount.(4)
- Study the relationship of Spirit Path and the highly color-charged flower garden in Beatrix Farrand's garden created in Seal Harbor for the Rockefeller Family. This is a Stroll Garden successfully linking the extremes of spirituality and exuberance.[1]
- Study photographs of contemporary South American gardens by Roberto Burle Marx where design strength is achieved through a reductivism expressed in abstract color and textural forms related in sophisticated occult balance and where the "stroll" is through a three-dimensional piece of sculptured garden.[5,6,7]
- Visit the Abby Aldrich Rockefeller Sculpture Garden at the Museum of Modern Art in New York, designed by Philip Johnson. This Stroll Garden can hold large numbers of people and works of art. In its most recent form there is a strong indoor/outdoor relationship to the galleries themselves and, as in its original conception, there is a finely tuned occult balance in each of its several areas; a fine tuning of scale which gives the feeling of being in a residential setting; and strong and economical linkage of all the parts.[8]

Conclusion

I make the plea that we study the principles developed by Japanese garden designers over the years; that we apply these principles to developing a kind of garden design that not only responds to our own culture, but to our specific house sites and personalities. The tempo of our daily lives and the insecurities of our world situation call for strong medicine in our garden design and I feel this can best be accomplished by a variety of experiences, some of exuberance, within the same garden. This can only work on a framework of design strength about which we have much to learn from our friends in Japan.

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[1] *Built Landscapes, Gardens in the Northeast,* (Catalog of a traveling exhibition produced by Brattleboro Museum and Art Center); 1984.

[2] Bye, A.E., *Art Into Landscape, Landscape Into Art,* PDA Publishers, Mesa, AZ, 1983.

[3] Rose, James C., *Creative Gardens,* Reinhold Publishing, New York, 1958.

[4] Church, Thomas, Grace Hall, and Michael Laurie, *Gardens are for People,* (Second Ed.), McGraw-Hill, New York, 1983.

[5] Bardi, P.M., *The Tropical Gardens of Burle Marx,* Reinhold Publishing, New York, 1964.

[6] Carter, Allen, "Gardens: The Hidden Valley," *ARCHITECTURAL DIGEST,* March, 1980, pp. 114-119.

[7] Gregory, Frederick L. "Roberto Burle Marx: The Brazilian Extravaganza," *LANDSCAPE ARCHITECTURE,* May 1981, pp. 346-357.

[8] Kassler, Elizabeth B., *Modern Gardens and the Landscape,* The Museum of Modern Art, New York, 1964, pp. 36, 48-49, 53, 62-63, 66-67.

[9] Ibid. pp. 58-59.

PART II

ARMISTEAD BROWNING, JR.

It isn't an exaggeraton to say that Americans are obsessed with Japanese gardens. Hardly a month passes without another magnificent book on Japanese gardens appearing in the book stores. Articles on Japanese gardens are appearing with increasing frequency in magazines. The first Brooklyn Botanic Garden handbook on Japanese gardens went through six printings from 1961 to 1979.

And we build them. Sadly none of them really look right. It is both a harsh truth and perhaps the most profound lesson conveyed to us by Japanese gardens that the only place they work really well is in Japan. Wedded to their environment, they are both an expression of one of the most powerful cultural traditions the world has ever seen and a distillation of a spectacular landscape at once dramatic and delicate. The overwhelming differences between American and Japanese culture and landscape, as well as differences in the way gardens are made and maintained, make it almost inevitable that a Japanese garden in this country appears forced or out of place.

The few Japanese style gardens that do succeed are either didactic or exceptional, independent feats. The former do not pretend to be anything other than a display of Japanese art principles for educational or museum purposes. They express the intangibles of Japanese landscape design while using elements of the U.S. landscape—an almost impossible job. The latter are the rare products of an individual's art and building process so brilliant that the culture and landscape of Japan are evoked along with the actual garden—an even more impossible task.

But we can learn from Japanese gardens, and there is a delicious irony in all of this: Japanese gardens evolve from a culture and landscape alien to ours, but they teach us truths that apply to our own Western tradition of gardening. We *can* become better garden designers and garden makers by understanding principles and techniques used universally in the creation of Japanese gardens.

There is another point to make about the great appeal Japanese gardens have for us. Despite the cultural chasm between west and east, something in Japanese gardens bridges the gap. The strong spiritual and philosophic messages conveyed by Japanese gardens somehow fill a void existing within our own culture.

The Japanese Garden

Store the whole world
in a grain of millet.

Zen Haiku

There is one misconception about Japanese landscapes to bury forever. Japanese gardens are not miniature land-

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ARMISTEAD BROWNING, JR. *is a landscape architect and teacher of landscape design. After traveling and studying Japanese gardens in 1981, he taught a month-long course at the University of Delaware and has given lectures.*

scapes. Miniature implies merely a smaller version of something, as a doll house is a smaller version of a real house.

The most significant idea that should be mastered is the Buddhist idea that the whole of the universe is contained even in its smallest part, as the haiku above suggests. This principle is a guiding beacon in Oriental philosophy and creative process. Consequently a Japanese garden, in effect, encompasses all of nature. It acts as a summation of nature—of its parts, of its binding energies—not a reduction of it.

The concept of worlds within worlds is directly applicable to garden making especially in reference to a new garden concept—the so-called ecological garden, born of the environmental movement in the United States. Among other things, the new ecologic garden emphasizes or brings into the garden elements of the natural world such as rock outcrops, wetlands, dead trees, animal and bird habitats, not simply for decoration but as expressions of natural process. Ecologic gardening is an affirmation, a celebration of the processes of nature and is based on an understanding of natural processes and of the relationships between the component parts of nature: water, soil, decay, animals, weeds, seasons, moon and rain. Events and items in the ecologic garden act then as a summation of the natural world and the forces that hold it together, in very much the same manner as they do in a Japanese garden. Accordingly, an American garden maker in the new ecologic garden tradition might base the garden around an existing swamp (water), an outcrop of schist (rock), or a thicket of sassafras (plants). In the design process, the designer adds or subtracts elements until the garden is complete as a distillation or summary of nature set within its originating landscape context. In this way, the ecologic garden parallels the manner in which Katsura or Ryoanji act as summaries of landscapes. The manner of their creation and appearance of the products are different, but the principle behind them is the same. Both Japanese gardens and ecologic gardens respect the natural world.

Photo by Betsy Kissam

Mass and Space

At the most basic level, landscape design is the creation of space using framing and enclosing elements such as plants, landforms, fences, ground plane and sky. Space is framed from all sides and from

Even in winter, garbed in snow, the Japanese garden is tranquil and evokes a sense of peace.

top and bottom and is enlivened by focal points and accents within the spaces and by views reaching out over the landscape and visually connecting other spaces. Movement through the spaces is created by the designer with paths and quickened by accents or views along the route. Although all the elements of the landscape can be utilized in the development of space (rocks, water, soil, landform), plants are of particular significance for obvious reasons of beauty and interest.

It is easy enough to outline one designer's skeleton version of the landscape design process as I have done here and even to build spaces in the landscape. What is much harder to do — and this is the measure of success in landscaping design — is to infuse those spaces with the mysterious ingredients that provoke an emotional response.

The Japanese garden often represents exceptional achievement in the development of mass/space relationships, which act as a powerful carrier of mood and feeling. The *means* by which this is done serves as an instructive, forceful example to garden makers in this country. Consider the first view the visitor gets of Sento Gosho, an Imperial villa garden, initially built in the early 1600s. The relationship between the placid, calm ground plane of the pond and the tumbling, turbulent enclosing masses of vegetation presses in upon the viewer, yet is held at bay by that polished mirror or repose. The visitor feels the power and mood of the place, caused specifically by the way the enclosing and framing elements of plant mass are built up and articulated. The rhythms and heavy masses of the enclosing plants are relieved by the pine tree acting as an accent, leaning in the direction of a lovely grassy clearing, itself framed by dense vegetation and by the pond surface. And finally, there is an absolute economy of means utilized in this composition: a pond, clusters of rocks used as accents, a leaning pine tree, a grassy patch, and masses of green vegetation.

The Idea of Journey

It has often been pointed out that one of the major differences between Western gardens (particularly French) and Japanese gardens is that in the Western garden everything is visible — there are no secrets. Whereas in the Japanese garden, although the route is clear, a part of the garden always remains hidden. There are secrets and mysteries which lurk just behind the visible: the garden viewer is invited to embark upon a journey of discovery. The theme of the journey has to do with the Japanese philosophic imperative, that of setting up gardens as vehicles to guide humans into an understanding of their oneness with nature, and so to the ultimate goal of harmony, peace and fulfillment. The Western garden designer can appreciate the procedures used in setting up the journey in a Japanese garden purely from a design point of view and as an instructive model to stimulate his thinking in the building of his own garden.

To the American garden designer, the specific techniques used by Japanese designers to create journey may not always work in this country. What is important is the use of Japanese gardens as conceptual models for developing the *idea* of journey in Western gardens, using Western procedures and techniques. Imagine how the short trip from garage to front door could refresh the tortured breadwinner if the traditional concrete sidewalk to the front door was a progression as a garden of discovery.

The Role of Plants

One flower opens, spring everywhere.

Zen Haiku

Many Western observers regard the pruning, shaping and supporting techniques used by Japanese gardeners as excessive, manipulative, and distorting. From the Japanese gardener's viewpoint, however, the shaping process comes from an understanding of the tree so that its essence is revealed. In effect, the gardener takes away from the plant that which is superfluous so its final form reveals its inner being.

There is much that the Western gardener can learn from this. Not Japanese pruning, shaping and support techniques, of course - that is the product of 2,000 years of evolution in a different cultural tradition. But doesn't a better garden often result when attributes of plants other than bloom, color and the purely ornamental qualities are explored? Attributes such as shape, bark, winter interest, age, relationship to animals and birds and variation in form.

The last great lesson out of the Japanese tradition with plants has to do with simplicity and economy of means Often the plant palette of the grea Japanese gardens could be described as few visual highlights against green tapestries and layers. The prevailing color is green. Blooming plants are few and far between. Too many would be a violation of harmony and would shatter the mood of peace and repose so essential to meditation and spiritual refreshment. Besides, isn't the beauty and delicacy of a certain plant that much more beautiful when it isn't overwhelmed by a mob of competing blooms and colors. As the introductory haiku suggests, one flower is all that is needed to suggest spring.

A Final Note

The country is ruined: yet
mountains and rivers remain
It's spring in the walled town,
the grass growing wild.

Japanese Haiku

Presently the world is in the grip of an environmental crisis. And at its fundamental level, the environmental crisis is a crisis in perception in which the unity between all the world's parts, the oneness of man and nature, has not been understood or expressed by the dominant cultures. As long as cultures believe that earth and humans are separated from each other, that somehow humans are cast in the image of the sacred, but the earth is not, then it's easy to justify the plundering of earth to supply a culture based on material goods.

There hasn't been a landscape tradition that transcends the Japanese garden as an expression of the harmony of earth's parts, the oneness of all of life, the respect and reverence due to all of nature. We are drawn to the Japanese garden without really knowing why, but with profound yearning. The garden is mysterious, green, unadorned, peaceful. We feel at home in these gardens.

Any long term solution to the environmental crisis will require a long journey in awareness. Doesn't then the Japanese garden embody both the journey and the destination? Isn't this its greatest lesson to us all?

"SAND FOR DRY GARDEN"

Many of the articles in this handbook refer to dry gardens or sand gardens. It has been mentioned that the term sand is used loosely—it is actually gravel or turkey grit.

Washed gravel made up of uniformly sized particles can be raked into patterns but does not look satisfactory. By combining several sizes of poultry grit the proper combination of texture, light and shadow can be achieved.

2 parts "grower" size
1 part "turkey" size
1 part "turkey" finisher

(*Turkey grit is available through livestock grain and feed stores.*)

This mixture will hold the patterns raked into it while presenting the most pleasing effect.

ADAPTED FROM AN ORIGINAL ARTICLE, *PLANTS & GARDENS*, VOL. 17 #4, 1961

There is at least a little Zen influence in every Japanese garden. This is the one a
the University of British Columbia in Vancouver. PHOTO BY GEORGE TALOUMIS

ZEN IN JAPANESE GARDENS

Kim Sorvig

The stone garden at Ryoanji, Kyoto is a quintessential Zen garden. Such a garden (and there is at least a little Zen influence in every Japanese garden), is difficult and risky to try to "explain." It is a matter of sensing, of feeling — the "Aha!" of insight. When asked to explain, shallow symbolism is tempting but misses the essential point. Zen is about experience; personal, direct and unifying, and Zen gardens are expressions of that experience.

Zen is a sect of Buddhism which places total importance on meditation; indeed, the name *zen* itself comes from the Sanskrit word for meditation. This practice is not the passive contemplation of an external deity or truth. Rather, it is a dynamic, still "centering" of awareness, in which one has insight into and direct involvement in "truth," "deity," or "universal energy." This awareness is "beyond explaining," and even Zen's own scriptures laugh at themselves and at anyone who memorizes or tries to read symbolism into them. Zen teaching is full of riddles (*koans*) that demand involvement, and one is often told to become *one* with the riddle; then the whole world unites behind a personal response to the *koan*, often immensely humorous, and seldom other worldly. Nirvana, the great liberation, is to be found in *samsara*, the real-yet-illusory world of the here-and-now.

What, you may ask, does this have to do with gardens?

A garden is one of the most direct expressions of human attitude toward the universe and the living environment. Most Western gardens, until recently, have been based on the attitude that this world is one of sin and imperfection, from which an escape to a "paradise" is desired, or upon which an abstract ideal order must be imposed. Western gardens, by and large, are either idyllic escapes or geometric "improvements," and are very often highly symbolic of some heavenly or romantic vision, or of hierarchic order and power, or both.

The Zen attitude is quite different, and so are its gardens. By meditation one realizes that one is united with the whole world, but is neither so oppressed by it to want only escape, nor so all-powerful as to try to impose one's will on it. As expressions of this attitude, Zen gardens show the touch of human hands that accept, understand, and are harmoniously involved in the natural environment.

In such a garden, symbolism is superfluous—not unacceptable, but only a paraphrase not to be taken too seriously. The rugged "island" at Konji-in, in Kyoto, crowned with an ancient gnarled conifer, is not "symbolic of" long life—it is long life! The fact that it *also* resembles the shape of a tortoise, a long-lived animal, is a wonderful gloss, but only a footnote. Mistaking this graceful, humorous counterpoint for the fundamental melody is common, even among the Japanese. One Zen writing refers to this sort of nearsightedness as "slandering the sky by looking through a pipe."

In a Zen garden, rocks are rocks; the art of placing them is best learned by "listening to them" until one knows where *they* want to be. A human teacher or book can only help open one's ears so that one hears the garden more clearly. Plants are likewise plants. And human artifice is also just that, human activity seen in relief against the background of natural elements speaking for themselves. Humans, too, are natural elements; yet we are aware of the world, and awareness shapes us and the world both. Thus, where Zen hands alter nature, it is to clarify the natural event (as when trees are pruned or boulders juxtaposed to accentuate their unique forms); or to show human relationship to nature (as when a clearly cut, squared stone is introduced among naturally-shaped ones in a path). Both effects are very powerful, enough so that people brought up on the Western idea of humans-versus-nature often find the accentuated result "artificial," again completely missing the point.

In the Zen garden, every element is the whole, and is whole in itself. This is not because the rock represents a mountain, or because the garden symbolizes the world outside. Rather, it is because of a profound belief that the universe, the human mind, and the smallest, plainest flower or pebble are governed by the same forces, so that the microcosm is a macrocosm. This pervasive attitude in Japan, to which both Zen and Shinto contribute, is easily misinterpreted by Westerners a superstitious or symbolic. It is neither.

Not every Zen garden, much less all Japanese gardens, fully achieve this quality of "being what they are," but there is usually a trace at least. It may be in the illusions which remind us that perceiver and perceived are One—the tiny courtyard that feels like a forest glade, or the small window revealing a few bamboo stems which makes one believe that beyond the wall there is a vast jungle. It may be in the integration of interior with exterior, through borrowed landscape, or through the interweaving of house and garden spaces. It may be in the *absence* of things which suggest human meddling — the lack of gaudy double-flowered hybrids, the emphasis on the lasting forms of rocks and evergreens, the gentle poverty of means, the local materials, the keen observation and faithful suggestion of nature's handiwork. Being what they are, everything is The One. Those masterful gardens which fully express this are characterized by an immensely resonant depth, and inspire attentive, energetic quiet.

But beware of the lure of explanation. What I have written here is rubbish; "useful lies," some Buddhists call it. To truly understand the Zen garden, sit quietly in one, relaxed yet alert, until all explanations are forgotten and you and your environment become "not two, yet no one." Then you will know what I really should have said.

WORKING FOR SONE-SAN AT TENRYU-JI

CLAIRE E. SAWYERS

Early one morning soon after I had begun working there, it was raining too hard to sweep the gravel walkways. I followed Sone-san (Mr. Sone) down to the lake to observe the garden. Looking across the rain-dappled lake to the rocks and trees that had taken on deeper hues, he asked me in broken English if I knew about the rocks creating an island on the far side of the water. Sone explained: the middle rock is the peak of Mt. Horai — the island of the gods and goddesses in Chinese mythology — barely rising above the cloud layer of lake water. While those, he indicated waving towards four low stones in a line, are ships tied in a harbor protected from a vast ocean. Sone drew the conclusion for me: this is the nature of Japanese gardens, within a few meters, a lake is two contrasting things simultaneously — lofty clouds and a vast ocean.

Through a ripple of events I became an apprentice for a Japanese professional gardener, Saburo Sone, curator of Tenryu-ji's gardens and grounds.

Many mornings, once Sone and the other workers arrived, we each armed ourselves with a broom made of bamboo twigs and swept the gravel towards the center of the walkways and collected the fallen leaves. Miura-san, the most advanced apprentice, also raked the white gravel garden every two or three days to freshen the pattern. Sweeping took until morning tea-time. When Sone indicated it was time to break, one of the others would run back to the work shed and prepare a tray with tea cups and teapot full of green tea. Sometimes we sipped for a half-an-hour, but just as often, attempting to finish other work, we didn't break until lunchtime when we returned to our *bento* or box lunch of rice, fish and vegetable pickles.

Cleaning the paths was a frequent and predictable task, yet it provided no clues about the work lined up next. Jobs ranged from relocating a stone lantern in the enclosed garden of a subtemple to wiring-up bamboo poles around a dog pen for the head-monk. During those early spring months, we constructed two stone walkways, one circling a newly renovated pavilion on the compound's central avenue, the other beautifying monks' gravesites behind the main garden. We added several camellia and pine trees to the grounds; we dug bamboo shoots encroaching on the other parts of the garden as soon as they appeared; we drained and scrubbed the spring-fed fountain inside the garden periodically and collected the coins visitors had

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Saburo Sone-san wears the traditional working garb: a simple shirt covered by *happi* and baggy pants.

A majestic pine grows in front of the main temple at Tenryu-ji.

thrown in. On one occasion we drained the large H-shaped reflecting pool at the complex entrance to plant sausage-shaped lotus tubers in the mud. We built several of the fences during the spring with fresh green bamboo and once we sprayed the famous cherry trees .

The Sone-zoen

I think Sone took me on partly for nostalgic reasons and partly so he could show-off his command of English. He had attended two years of college in Oregon many years earlier.

Sone and his two brothers were in the landscaping business together. His brothers as well as his wife and children lived in Osaka, about an hour away from Kyoto. Sone was establishing the business in Kyoto while his brothers built residential gardens and landscape projects in Osaka. He kept an apartment in Kyoto and maintaining the traditional apprentice system, his workers lived-in, receiving room and board as part of their compensation. Once when I was invited with them to a holiday party, I went to their Kyoto apartment for dinner before the celebration. We cooked and ate in one small room, while nontraditional bunk beds filled the other room (perhaps an idea Sone picked up from his American college dormitory life).

The Garden

On the rainy day Sone took me down to Tenryu-ji's lake and enshrouded Mt. Horai, the legendary island of the immortals, he willingly passed the rainy morning away telling garden stories that the other apprentices probably knew well from studies. Sone searched for the English to make certain I understood. Continuing with the rocks, he pointed to the opposite shore of the lake to the gray, jagged, lichen-covered stones which looked like a gushing mountain stream. It is known as *Ryu-mon-no-taki* which

Elderly women swept and weeded at Tenryu-ji. Their costumes resemble those of their male counterparts except for headscarves rather than male headbands. Everyone had tea together during breaks. Photos by Claire E. Sawyers

ranslates as "Dragon Gate Waterfall," he name of a waterfall of the Yellow River in China. According to a Chinese myth, golden carp struggle upstream in he Yellow River and if they succeed in ascending the falls they turn into dragons. Just at the foot of the waterless waterfall at Tenryu-ji, a stone known as he "carp stone" peaks its head above the ake's surface. There is a joke in this. In ancient China a person who became a government official by passing a civil xamination was said to be a carp conquering the falls and becoming a dragon. The stone carp has looked longngly on the cascade at Tenryu-ji for enturies.

Sone went on to explain *shakkei*, or orrowed scenery, a unique Japanese andscaping technique. The stones of *Ryu-mon-no-taki* so strongly suggest a mountain stream, he said, that a visitor looks to the surrounding mountains, imagining the water sources. And so the mountains become a part of the garden.

Three naturally flat rocks bridge the lake in front of the waterfall. Sone explained that those stones bridging the imagined white water represent three sects of Buddhism — the Jugaku, Buyo, and Dokyo sects — thus they comment on religion's role in making life's difficulties surmountable.

Besides the distant Mt. Horai there is another rocky island on the near side of Tenryu-ji's lake. The sign staked on the mound reads "tortoise island" and with some imagination and Sone's help I could see a head poking out of the water and four limbs. The inanimate tortoise brings life into the lake, but more profoundly it brings longevity, since in Japanese mythology the tortoise lives 10,000 years. Tenryu-ji's tortoise island is uniquely connected to the lake's shore by an ornamental stone bridge. Was the designer suggesting Tenryu-ji is the bridge to longevity?

From the lake's edge we followed a delicately channeled stream to higher ground and came to the spring-fed fountain just behind the Zen meditation pavilion. We paused beneath two massive weeping cherry trees within hearing range of the gurgling water of the fountain. For the few early spring days the trees bloom, the garden overflows with visitors who come to gaze up through the green bamboo lattice which supports the sky of pink petals. I felt the fever of the pleased tourists who captured the blossoms in their prime. When I commented then about how disappointed the late-owners must have been, Sone disagreed. He said the Japanese understand the cherry blossom's intense beauty is due to its ephemeral nature.

Tenryu-ji's History

Inside Tenryu-ji's garden, especially in the early morning before tourists arrived and while the monk's chimes and gongs softly penetrated the shoji doors, it was easy for me to forget the modern Kyoto I had just traveled through and imagine the characters in Tenryu-ji's past.

Arashiyama, the area around Tenryu-ji, was popular as a resort as early as the 9th century, according to Loraine Kuck in *The World of the Japanese Garden*. Courtiers retired to the spot increasing its popularity and historians think that when emperor Gosago moved to Arashiyama permanently, the garden of Tenryu-ji emerged. Gosago's grandson, Godaigo (1287-1339) grew up there and following the pattern, became emperor.

Eventually courtiers abandoned the villa in Arashiyama. It declined and by then General Takauji was attempting to overthrow Emperor Godaigo and succeeded in pushing him out of Kyoto. The Emperor retreated to Nara where he suddenly died. Takauji feared revenge from the Emperor's ghost, but he eased the situation by following a suggestion from Muso Kokushi, monk of the nearby Moss Temple (Saiho-ji). Kokushi proposed the Emperor's spirit be enshrined at his old villa and childhood home in Arashiyama. The result was the Temple of the Heavenly Dragon or Tenryu-ji. Muso Kokushi became head monk of Tenryu-ji, and some give him credit for the garden design as it stands today. Historians also debate whether the name of the temple refers to Godaigo as the "Heavenly Dragon" or alludes to the myth behind the rock waterfall in the garden.

Farewell

I worked for Sone two months, never really feeling a part of the crew since I was foreign, female, and wasn't living-in like the others. That distance disappeared when it came time to leave. On my last day of work Sone presented me with a valuable memento of Tenryu-ji: a calligraphy piece brushed by the head monk. The characters read shizuka or "quiet" describing a zen-concept, but to me it also described the garden. After work, Miura and the others took me downtown and selected a souvenir of modern Japan for me—a wristwatch. On to a prestigious restaurant where we dined in a private room, consuming at least seven courses. Over dessert the other apprentices gave me books on Japanese gardens. They had filled the inside covers with characters which wished me luck.

The farewell party continued unti early morning, and after all the songs they knew had been sung, they called a taxi for me. As I waved goodbye out the cab window, I caught a glimpse of my "souvenir-of-Japan". If I hadn't been leaving, it would have been nearly time to catch the bus for Tenryu-ji.

KOI: THE COLORFUL CARP OF JAPAN

JOSEPH S. ZURITSKY

Koi are the same species of fish (carp) that live in many of the streams and rivers of the Continental United States. They differ only by their colors. In China, the cultivation of carp for food and later for pleasure goes back over 2,000 years. Writen instructions on the raising of carp date back to year 500 BC. Carp was cultiated because it grows fast, is extremely hardy and thrives in most of the climatic ones humans inhabit. After the ntroduction of carp from Asia Minor into China and then into Japan, the species started to attract interest. As time passed, color mutations appeared in the spawnings and these separated and then selectively bred to improve color and subsequently patterns. Thus, from the homely carp slowly emerged today's magnificent *nishiki koi,* or brocaded carp.

Over the years, the carp came to symbolize strength, wisdom, and courage to the Japanese and many legends grew up about their virtues. Since parents hoped their sons would possess the same positive traits as the carp, each May 5th, on Boy's Day, parents would fly one carp-shaped flag outside their homes for each of their sons. This tradition still thrives

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OSEPH S. ZURITSKY, *attorney and business xecutive, has been a koi hobbyist for about 15 years nd now operates Quality Koi Co.*

and May 5th is a colorful event with thousands of carp 'swimming' in the wind on flag poles above Japanese homes.

Koi can grow to be over three feet in length, weigh over 30 pounds (although most seen in gardens are about half that size) and live more than 50 years. They eat almost anything of animal or vegetable origin small enough to be swallowed as they have no external teeth. The finest quality koi are bred in Japan where raising koi is a $100 million a year business but the hobby of raising and showing koi has attracted thousands of persons in scores of countries.

Koi are bred primarily for the color and patterns on their backs because their backs are most visible as they swim in ponds. Koi are classified into color, pattern, and scale types, and although each type allows some leeway for originality and faults, the color, pattern, and body shape are specifically enumerated much the same way dogs are judged in the United States.

Each patterned koi is like a work of art; each is different, but as with art very few are considered masterpieces. Those few koi which become champions at the large shows in Japan *are* considered masterpieces and have sold for more than $20,000 each. The reason for the high values is that even the best quality koi do not reproduce high quality young in large numbers. Out of 200,000 newly hatched young, less than 200 will be of salable quality and often none of show quality. After the laborious task of culling thousands to find the special few, the tiny koi must be nursed through their first years of life when they are vulnerable to disease, parasites and predators. Changes in color and pattern also take place during this time.

Keeping koi healthy requires duplicating as closely as possible their natural habitat which means the water must be clean and unpolluted. A natural spring-fed pond is ideal as the water is continously changing and need not be filtered or aerated. Since conditions hobbyists must contend with are rarely perfect, artificial means have been devised so koi can be grown almost anywhere: homes, public places, businesses, indoors or out. Ideal artificial conditions include proper filtration, aeration, water depth, amount of shade, and adequate water changes.

In a Japanese garden, one might wish to keep 25 to 35 large koi (18 to 28 inches) in a pond measuring almost 10 feet by 20 feet with a depth of four feet. However, the natural oxygen level of this pond would not be sufficient to sustain that number of fish. To permit koi to survive in these conditions, the oxygen level of the water can be raised by either adding a vigorous waterfall or a mechanical aerator. In addition, if the water merely recirculates, it quickly becomes poisoned by fish wastes and decomposing food if adequate filtration is not provided. This can be accomplished by creating a biological filter in which aerobic bacteria in the filter consume fish waste and excess food, removing dangerous chemicals and purifying the water. The filter box should be constructed to route pond water through four to six inches of 1/4 inch crushed granite. Within three to four weeks the aerobic bacteria multiply into sufficient quantities within the gravel bed to filter and purify the water and will continue to do so if water passes through the gravel a the rate of two to four gallons pe minute for each square foot of filter surface. Pumps should have about 0.1 horsepower for each 1,000 gallons, so a 1 horse power motor should serve a 10,000 gallon pond.

Fresh water should also be added to koi ponds. Each week about 10% of th pond water should be removed an replaced by tap water. One way this can be accomplished is to allow a dribble of tap water to flow into the pond continuously with the excess water flowing into the overflow drain, but first find out if your water company adds chloramine plus chlorine to purify its water. If so, a system must be devised to remove the chloramine from the water.

Although koi can survive limited periods of temperatures as low as 25 degrees or high as 100 degrees F, they are most comfortable in 65 degrees to 75 degrees water with 68 degrees being perfect. Quick changes in temperature stress the fish and leave them weakened and open to attack by bacteria and parasites. Ponds made in the ground are insulated by the ground and their temperature changes slowly. The key variable in moderating temperature changes is the depth of the water; the deeper the water, the slower the temperature will change. Most experts advocate a depth of four to five feet although it is possible to keep koi outside in slightly shallower ponds (not less than three feet).

Most ponds are constructed of reinorced concrete, but PVC or rubber iners are also usable as is any water-holdng container which won't poison the vater. Ideally, ponds should have ounded corners for good water circulaion, smooth sides so as not to damage .oi scales, and steeply-sloped bottoms 30 degrees to 35 degrees angle) with a ottom sump drain to eliminate solids nd wastes from the pond without utting them through the filter. Steep des also allow the movement of the fish nd the water currents to move heavy olids into the bottom sump. The sump hould be made so that the opening of a alve allows heavy wastes and dangerous mmonia, which also collects in the ump, to be drained into a sewer or ench drain. Lastly, for clearer water ithout algae (green water) a skimmer should be incorporated into the pond, and the pond should be built mostly in the shade.

Koi are normally bottom feeders, but by feeding them floating foods they learn to feed at the surface where they can be appreciated. With patience, koi can be tamed and will even feed from their owner's hand. The addition of koi into a traditional Japanese pond provides the finishing touch of life and beauty to one of man's highest artistic achievements, the Japanese garden.

Koi dealers to contact for further information and/or Koi:

ASAHI FANCY KOI, INC.
1051 W. 190th St.
Gardena, CA 90247
(213) 532-2020

CALIFORNIA KOI FARMS, INC.
3360 Gird Rd.
Fallbrook, CA 92028
(619) 728-1483

KOI BREEDERS
P.O. Box 4
Newberry, CA 92365
(619) 257-3653

NISHIKI KOI
FUJIWARA SHOTEN LTD.
313 Santa Barbara St.
Santa Barbara, CA
(805) 963-4224

QUALITY KOI CO.
1355 Bobarn Dr.
Narberth, PA 19072
Joseph Zuritsky
(215) 563-3336 (day)
(215) 667-7340 (eve)

GARDENA KOI & GOLDFISH FARM
816 West Gardena Blvd.
Gardena, CA 90247
(213) 327-2872

NOTEWORTHY BOOKS ON JAPANESE GARDENS

Elisabeth Woodburn

Both historic and contemporary views of a subject frequently show the bias of their times. To examine a subject via words and pictures of one period and then compare these images with a later time period is often an interesting comment on history itself. In the almost hundred years between Edward S. Morse's ***Japanese Homes and Their Surroundings***, published in Boston in 1886 and the large, beautiful volume of Kanto Shigemori's ***The Japanese Courtyard Garden***, published in New York in 1981, the gamut is run from the early describer of a mysterious far-away land for fellow occidentals, to a Japanese describing small gardens for possible emulators.

The number of books published between 1886 and 1984 show the continuing interest of the Western world in the way the Japanese use plants and nature to create gardens. The greatest — and the first — of all the books on various components of the five styles of Japanese gardens was by Josiah Conder. ***Landscape Gardening in Japan***, published in 1893 in Tokyo, was followed in 1895 by ***Supplement to Landscape Gardening in Japan***. These tall volumes have color illustrations (Japanese wood-block style), 40 heliographic plates, and pages of detailed drawings of fences, ornaments and paving so extensive that no one since has provided such a wealth of detailed information. A second edition was published in 1912. A paperback edition, reduced in size and without color plates was published in 1964. Most horticultural libraries will have this work but it is becoming difficult to find in book stores. It should be examined by everyone who wishes to see the style of Japanese gardens before Western 'interpretation'.

There are several other early noteworthy books on Japanese Gardens:

European and Japanese Gardens with the section on 'Japanese Gardening' ('Notes to the Lantern Slides') by K Harada was published in Philadelphia i 1902. It was edited by Glenn Brown fo the American Institute of Architects. Th illustrations and brief factual text ar informative and indicative of the precis nature of the symbolism.

The Flowers and Gardens of Japa described by Florence Du Cane an painted by Ella Du Cane was issued i London in 1908 as a volume in A. & C Black's popular series of color plat books. The author states that althoug there are many books on Japan there wa no book giving a short account of th flora of the country which is so ofte called 'The Land of Flowers'. She als says that most of her knowledge of th gardens is derived from Mr. Conder

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Elisabeth Woodburn *delights gardeners with old and new horticultural books at Booknoll Farm. She has traveled to Japan and articles about her have appeared in* ***Horticulture*** *and* ***Garden Design***.

work. She makes no mention of Sir Francis Piggott's ***The Garden of Japan: A Year's Diary of Its Flowers***, also published in London, in 1892, with four color plates of flowers and a diary-type text which gives accounts of the Japanese appreciation of flowers and gardens throughout the year.

Another popular book of this period was Mrs. Basil Taylor's ***Japanese Gardens*** (London and New York, 1912) with 28 color impressionistic pictures by Walter Tyndale. Mrs. Taylor also acknowledged her debt to Mr. Conder. The continued demand for works on all aspects of Japan was reflected in the several reprintings of both the Du Cane and Taylor books. In this country the remarkable Japanese xhibit at the 1876 Philadelphia Centenial Exhibition sparked an interest in apanese plants and gardens. These early itles continue to be pertinent as direct eports of what Westerners found most nteresting.

At the same time these Western publiations appeared, a number of Japanese ublished books on their gardens. They ill not be included in this brief list as hey are not common, however, many elightful volumes exist in Japanese. hey are frequently small, specialized orks on such subjects as stone basins, one lanterns or paving.

Increasingly, the Japanese works have ecome available, either written in nglish or translated for us. Some panese works appear with names of lants in Latin or English, with perhaps a age of introduction in English as in the quisite volume ***Japanese Alpine Plants***, lustrations by Bunsai Ioki, with introction and notes by Hideaki Ohba. This lio volume of 99 color plates of plants om Bunsai Ioki's rock garden was inted at the end of the 19th century d only recently published. It is interestg to note that because of the botanical curacy of the plates, the Japanese feel this book shows Western influences.

Between the two World Wars there were several books published which were widely distributed. The following titles are mentioned for their lasting interest. Jiro Harada's ***The Gardens of Japan***, which described the gardens chronologically, was well illustrated being one of The Studio Books and was published in London in 1928. Tsuyoshi Tamura's ***Art of the Landscape Garden in Japan*** covered history, principles and design with plans and over 190 photos. It was published first in Tokyo in 1935 and then in New York in 1936. The familiar little 'Tourist Library #5' ***Japanese Gardens***, by Matsunosuke Tatsui, began as a paperback in the 1930s and was being issued as a hardbound volume still in the 1960s. Samuel Newsom's ***Japanese Garden Construction*** (Tokyo, 1939) was beautifully produced and is still as useful as when it came out. Loraine Kuck's ***100 Kyoto Gardens*** contained a map for visitors to these famous gardens when it was published in London in 1935. It also had eight color plates. The same author's ***The Art of Japanese Gardens*** (New York, 1940) was informative and popular for years.

Shortly after World War II the stream of books on Japanese gardens started with such titles as Mirei Shigemori's ***The Gardens of Japan*** (Kyoto, 1949) with many photos including 16 in color. These make an interesting comparison with today's color photography in Japan. As the years have passed, the interest in Japanese gardens, as evidenced in the publications mentioned below, has increased in scope. There is a rough division in those which appear now, as the practical how-to-copy works, aesthetic appreciation, and guide books. Almost all the titles have elements of each category. Using these frequently blurry divisions, the following is an attempt to group some of the interesting modern titles.

Guide books such as Marc Treib and Ron Herman ***A Guide to the Gardens of Kyoto*** (Tokyo, 1980) is almost a model for what a specific, informative small paperbound volume can be. It is filled with background information, plans and visiting hours, both to aid in viewing and to remember. Two guides of a completely different nature are outstanding modern publications. ***Imperial Gardens of Japan*** by Teiji Ito has 210 pages of photographs (138 of them in color) by photographer Takeji Iwamiya and essays by several important Japanese writers. This sumptuous volume was issued in folio size in Tokyo and New York in 1970 (also later printings). ***Katsura, A Princely Retreat*** by Akiro Naito (Tokyo and New York, 1977 and 1982) is also a large volume covering one garden in depth with 94 color photographs, plans, architectural drawings, and a colored, folding map.

A book dominating the practical and beautiful category is Kanto Shigemori's ***The Japanese Courtyard Garden: Landscape for Small Spaces***, (Tokyo and New York, 1981). Seventy-five of Kyoto's gardens are shown in 93 color photos by Katsuhiko Mizuno. The 81 architectural plans included give the perspective needed to translate the photos into usable ideas. This, too, is a very large volume, beautifully produced. A much smaller book in this practical category is Teiji Itoh's ***Space and Illusion in the Japanese Garden.*** It was written to show two techniques of Japanese garden design — "borrowed scenery" and "the great within the small" — and how to create their special atmosphere. It was originally published in Kyoto in 1965 in Japanese, appeared in English in 1973 hard-bound, and then as a paperback in 1983. Other useful books for practical garden planning are: David Engel's ***Japanese Gardens for Today*** (Rutland and Tokyo, 1959 and later printings) with many photographs showing specific points made in the text; Tatsuo and Kiyoko Ishimoto's ***Japanese Gardens Today, How the Japanese Use Rocks, Water, Plants***, (New York, 1968) with over 200 photos with accompanying text; and Samuel Newsom's ***A Thousand Years of Japanese Gardens*** (Tokyo 1st edition 1952, 2nd ed. 1955) which makes its point page by page with a photo on the upper half and text below it interpreting the ideas. A final title in this category indicates the international scope of interest in these gardens. Tetsuro Yoshido's ***Gardens of Japan*** was translated from German in 1957. It, too, is well illustrated by photos, plans and drawings.

The aesthetic, or interpretive view is, of course, well taken in all the above titles. Three titles give special emphasis to this approach to Japanese gardens. Mitchell Bring's and Josse Wayembergh's ***Japanese Gardens — Design and Meaning*** (New York, 1981) is divided into sections which cover specific gardens, their particular style and how that is achieved. Masao Hayakawa's ***The Garden Art of Japan*** is a volume in The Heibonsha Survey of Japanese Art Book Series (New York and Tokyo, 1971, 1981 printing) which especially answers questions of historic background and meaning. Lastly Loraine Kuck in ***The World of the Japanes Garden: From Chinese Origins to Moder Landscape Art*** (New York and Tokyo 1968, 3rd printing 1982) presents goo historic as well as modern view enhanced by 212 illustrations (44 o them in color). A brief bibliograph included is helpful.

A complete collection of books abou Japanese gardens in Western language would fill a sizeable bookcase and keep collector busy for many years. The titl mentioned above have been carefull chosen for their helpful information an illustrations and because they can ofte be found in horticultural libraries. The capture a glimpse of Japanese garde for repeated savoring.

Practical handbooks to share the Brooklyn Botanic Garden's 76 years of excellence in horticulture, education and community service.

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New Horizons in Horticulture

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PROCEEDINGS OF THE 75TH ANNIVERSARY SYMPOSIUM

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FOREWORD

There were four days of celebration in May 1935, billed as "Exercises in Commemoration of the Twenty-fifth Anniversary of the Brooklyn Botanic Garden." About four hundred people came to what one staff member of that time remembers as a mixture of pomp and circumstance (addresses by Mayor Fiorello La Guardia, Commissioner Robert Moses and several other City and national celebrities) and scientific programs with reports on botanical progress and horticultural activities. A speaker had even been invited to come from England to discuss the role of women in horticulture. It was the most beautiful time of the Botanic Garden year, so there were tours of inspection of the Japanese Garden, Cherry Walk, the Local Flora Section, the Rose Garden and the then-new Horticultural Section, (now dubbed the Osborne Section). The program on the final day was concerned with botanical and horticultural education, which, says the same old-timer, was the bottom line, and she adds sagely, remains the bottom line at BBG today.

The Garden's first Director, Dr. Charles Stuart Gager, presided over all "the exercises," and no doubt derived much pride and satisfaction from the achievements of the Garden's first quarter-century. He commented, "A botanic garden is not like a statue or a building—it never becomes a completed work. It is an organic thing, beginning as a germ and continuing for all time toward a standard of perfection which will never be fully realized."

And so in striving for perfection, it behooves us at the Garden to stop and consider, to look at ourselves through the eyes of our peers from time to time. This we have done occasionally with visiting committees, but to celebrate the 50th Anniversary in 1960, a symposium was held on "Future Objectives for Garden and Horticultural Writers and Teachers." Dr. George S. Avery, BBG's second Director, saw the occasion as a great opportunity to highlight the Garden while promoting discussion among some of America's brightest horticultural personalities. Sadly, nature intervened in the form of a blizzard! The symposium was held in December, and was to have been the grand finale of a year of celebrations. Scores of invited guests were unable to travel to BBG on that day, but a small and distinguished group of people braved the elements to express their views on American gardens and ways in which we could educate the public not yet senstive to the green world. (To add to the excitement of the occasion, word came that the worst collision in aviation history to date had occurred within a few blocks of the Garden. Later part of one of the two aircraft involved was found in the Local Flora Section.)

1985 marked the Garden's 75th Anniversary, a year of great activity in every department, for construction of the long-awaited new conservatory complex had begun. This was also a time when questions were being asked across the U.S. about the nature of the American garden. Many of us at BBG thought our Diamond Anniversary would be a good time to examine the subject. A two-day symposium, to be held in early autumn and entitled "Growing in America: New Horizons in Horticulture," was decided upon. We were fortunate indeed to have the speakers of our choice agree to participate, and even more fortunate, in spite of another of nature's surprises, to have them arrive at 1000 Washington Avenue. Hurricane Gloria blew in on the first day of the two-day symposium and, as more than a hundred people had registered for the program, there was a considerable amount of soul searching about whether or not to go ahead with it. Since four of the speakers had arrived in New York the previous evening, we decided to do so, come what may. In fact John Creech told us firmly, "I have my slides and lecture ready and I'm going to give it!" At the onset there were four missing speakers, so a few schedule changes had to be made. Even though Mark Zelonis was one of the early arrivals, he received an SOS from his office at Blithewold Arboretum in Rhode Island to return at once and face Gloria in all her fury. Michael Dirr, Pamela Harper and Gary Koller called in at various times during the first day of the Symposium to assure us they would arrive if humanly possible. And arrive they did, as did Nina Bassuk. They came at various times during the second morning, bringing tales of all-night vigils in airports and elsewhere.

The Symposium was held, with all speakers present except Mark Zelonis, but he had prepared his remarks for publication and they are included in the record of the proceedings that follows. We have to thank Gary Koller for the suggestion of the subject of maintenance. It was he who pointed out that no garden remains great unless it is maintained properly.

A last minute "filler" by Elvin McDonald turned out to be a most important part of the program. A recent addition to BBG's gardening labor force, Elvin had assembled fascinating horticultural lore from his co-workers, which he put together in an hour and gave a captivating talk on gardening at BBG, with remarkable color slides to illustrate it.

Ever since the publication earlier in the year of the book "Plants that Merit Attention: Trees" (the first of a series by the Garden Club of America), we at BBG have paid renewed attention to the many trees planted here. We were delighted to find that 90 of the possible 118 trees hardy in this area are thriving in the Garden. After Janet Poor's fine lecture on the subject, we found that the weather had let up enough to permit a quick inspection tour of the collection. John Creech's talk on plant introduction sharpened our awareness of the excitement of the hunt and of our debt to those plant explorers who have given the American garden its rich legacy of cultivated species. Gary Koller, Pamela Harper and Nina Bassuk contributed further by showing a varied assortment of desirable plants and the specific uses for which they're available. Michael Dirr afforded us a prophetic glimpse into the future of U.S. horticulture. The program was steered by a splendid moderator, Allen Paterson, who also drew everything together in a masterful manner by revealing "What Makes a Garden Great." The stellar cast of speakers, in showing the way for the next quarter-century, inspired us all.

As I don't expect to be around in 2010, I would like to make one suggestion to the committee planning the "Exercises (or whatever) in Commemoration of the One Hundredth Anniversary:" Pick a good time of year to have the meeting and check the *Old Farmer's Almanac* for tornadoes, floods and earthquakes. The Garden will have much to show and tell, and it would be a great loss to have nature interfere once more.

P.S. Gloria's fury had abated by the time she reached Brooklyn. Apart from losing branches from many trees (natural pruning) only three large specimens were lost: a Schwedler Maple flanking Cherry Esplanade, a Crabapple near the Rose Garden, and a Japanese Black Pine at the North end of the Fawcett Memorial Section.

Elizabeth Scholtz, *Vice President, takes advantage of a respite from hurricane Gloria's wrath to survey the damage. She is accompanied by symposium participants.*

Plant Hunters and Their Garden Contributions

BY
JOHN L. CREECH

Frank Meyer *on his return from a collecting trip in the mountains of China. Photo reproduced by permission of the U.S. Department of Agriculture.*

I would like to discuss some of the contributions of plant collectors. They are important to garden development, both the home garden and the public garden. Although plants introduced by plant collectors are important, they are useless in isolation and without public gardens and experiment stations to evaluate and conserve those materials, they might never find their way into your gardens. On the other hand, many interesting plants have disappeared into the living collections of botanic gardens and arboreta, never to find their place in the outer gardening world. I want to discuss the contemporary developments in plant collecting and how they relate to the pioneer work done by earlier explorers. While it may appear that today's collectors are going over the same ground, they are bringing different viewpoints to the plants that will serve the gardens of the future.

I am particularly interested in the plants of the Far East and more specifically, the native plants of Japan. We are all familiar with the fact that Japan was

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Dr. John L. Creech, retired Director of the National Arboretum, Washington, D.C., has conducted plant explorations over the past 31 years.

a closed society for over 230 years and during that period the only foreigners allowed in the country for trading purposes were the Dutch. Being isolated on an island, Deshima, in Nagasaki Bay, it was their practice to include a physician among the trading company. These men were always interested in the native plants, probably firstly as herbal medicines and then as ornamentals. One such man was Engelbert Kaempfer who stayed in Japan from 1690 to 1692 and he is commemorated by a number of species, such as *Rhododendron kaempferi* and *Iris kaempferi*.

He was followed by another medical officer, C.P. Thunberg who remained in Japan from 1775 to 1776 and he, too, was interested in the native plants. The last medical officer sent by the Dutch who was to develop an equal interest in plants was P.F. von Siebold who stayed from 1823 to 1829. At the Deshima memorial site at Nagasaki there is a large stone on which von Siebold had the names of his predecessors carved and in the hospital garden that he was allowed to visit once a week, there is a commemorative statue to this great plantsman. These three were among the most important naturalists to explore the rich Japanese flora prior to the opening of Japan by Perry in 1854.

After Japan opened her doors to the western world, a number of plantsmen were attracted to the wealth of wild and cultivated plants, such as George Rogers Hall, who had been in China as a physician and transferred his interest to Japan as a trader. Hall gathered many plants in his Yokohama garden, eventually shipping the most outstanding to the U.S. in 1860–61. About the same time, a British collector, Robert Fortune was in Japan on behalf of the U.S. government to collect tea. In addition, he was attracted to the plants both in the wild and in Hall's garden and shipped a number of new plants to England, many that he obtained in Hall's garden.

One man who made a singular contribution by sending plants from Japan to western gardens is almost entirely overlooked in our horticultural literature. Louis Boehmer was a German immigrant who came to the U.S. in 1868 to work as a plant propagator in the famous Ellwanger and Barry nursery in Rochester. In 1872, when the Japanese asked the American government to create a team to help pioneer Hokkaido, Boehmer was chosen as horticulturist. For ten years, he served in this capacity, introducing fruits and other plants into Hokkaido, including

Pieris japonica*, scattered across a meadow in the Handakogen Highlands, Kyushu, Japan, is reminiscent of grazing sheep.*

hops which established the beer industry in Hokkaido. During his stay, Boehmer undertook a collecting trip to Hokkaido in 1874 and sent many plants to a testing facility near Tokyo. In addition, his herbarium material helped establish the Tokyo University herbarium. In 1882, when the Japanese government terminated the project, Boehmer moved to Yokohama and established a nursery company and began exporting new plants to western countries, particularly Germany and the U.S. Although Boehmer returned to Germany in 1892 because of ill health, his nursery continued until 1908. The Boehmer catalog, which we can find in several collections in the U.S. is beautifully hand illustrated in color and contains a wide assortment of plants, together with important details of their origin and culture. For example, he offered the yellow, orange, and red forms of *Rhododendron japonicum* and may have been the first to send these color forms to western gardens. Boehmer also exported a number of lily species for the first time.

With the turn of the Century, we entered the "grand period of plant collecting" in the Orient. E.H. Wilson was busy in China collecting the *Davidia* for the Veitch nursery and then shifted to the Arnold Arboretum in 1907 where he established his fame as a plant collector. Unfortunately his work in China was cut short by a serious accident in the field and while he continued to collect in other countries of the Far East, he never was to return to mainland China.

This left Frank Meyer, who was collecting economic plants for the USDA (U.S. Department of Agriculture), as the principal collector in the field in China. Actually Meyer was to spend the longest period of time in the field of any of his contemporaries and it is only now that we can read of his exploits in the recent biography, "Frank Meyer—Plant Hunter in Asia," by Isabel Cunningham.

Many of these events transpired around the time that the Brooklyn Botanic Garden was established (1910). It is possible that some of the plants collected i China at that time were distributed t BBG. There were not many publi gardens in existence, possibly twenty-tw and not all of these were engaged in testing new plants. As a result, the USD established a list of private cooperator who received plants sent from China an elsewhere by plant collectors. Even toda we can locate remnants of this distribution program from people who inquir about plants that carry a USDA Plan Introduction Number.

Although Meyer was directed to concentrate on economic plants, he ofte sent home ornamentals that caught hi eye. One of these is *Juniperus chinensi* 'Columnaris' which can be seen at th National Arboretum. It is still one of th best of the tall screening forms of thi variable juniper. Perhaps the most exciting of Meyer's collections was *Pyru calleryana*, best known through the cultivar 'Bradford.'

Actually, E.H. Wilson first sent seed o this wild pear back to the Arnold Arboretum but it apparently did not arouse an interest. During his last journey, Meye was directed to collect a thousand pound of seed of *Pyrus calleryana* because i was the most resistant species to fir blight of pears. Imagine how long it mus have taken Meyer and his Chinese assistants to collect the tiny cranberry siz fruit even when he had located a larg wild colony. He undertook this missio during a period of great civil strife, banditry and warring factions were everywhere. Once Meyer was trapped fo months in a village by the fighting. H had to break through the lines, walk som sixty miles to recover his precious collections and then make his way to the rive where he embarked on a riverboat onl to end his life by mysteriously disappear ing overboard. His pear seed eventuall reached America and was distributed t plant breeders.

Subsequently another USDA collecto was requested to revisit the place wher Meyer had collected his callery pear seed This material arrived safely home in 191 and while it never was successfully use in pear breeding, a remnant of the population was grown at the Glenn Dale Plant Introduction Station. When I arrived there in 1947, the row of trees had matured and I was asked to consider the ornamental possibilities of callery pear. I selected the most attractive tree for flower and foliage character and fall coloration, arranged to have a row planted in a nearby subdivision and ultimately named the selection for F.C. Bradford, who preceded me as superintendent of the Glenn Dale Station.

Now it is an all-purpose tree. Not only does it have superb form but recently landscape architects have been using it for espaliering. 'Bradford' is a good city tree, tolerant to the harsh environment, smog, and other polluting factors and it is well-suited to placement in the inner court. I would leave you only with the thought that it took some forty years before this introduction attained acceptance.

By the 1930s foreign exploration in China and the Orient had all but ceased. The enacting of Quarantine Law 37 that prevented importation of many kinds of plants and none with soil on the roots, totally discouraged the Arnold Arboretum from plant collecting shortly after 1920. The war clouds in China did not help. Probably the last collecting in that country was done by R. Kent Beattie who went to China for the USDA in 1927 and spent some five years collecting chestnuts to fight the chestnut blight disease. On this trip, Beattie stopped off in Japan and sent back a collection of azaleas that became the basis of Mr. Morrison's Glenn Dale azalea breeding program.

Although collecting in China was terminated, there was still activity elsewhere. In 1935, Edgar Anderson who believed that there were plants in middle Europe that would be well suited to the mid-regions of the U.S. undertook a collecting trip in the Balkans where there are populations of *Buxus sempervirens* growing along the Vardar River. Anderson sent back seeds and cuttings of the wild box from this remote river

***Ernest L. Wilson** collected in China. He brought back* Davidia *to England for the Veitch Nursery. He is surrounded here, in Formosa, by headhunters and Japanese policemen. From ERNEST H. WILSON by Edward I. Farrington, Stratford Co., Boston, 1931.*

valley and they were grown at the Arnold Arboretum.

Over the next several decades, various plantmen observed the Vardar River boxwoods and in particular Henry Hohman, of the Kingsville, Maryland nursery. He reported his observations to the Arnold Arboretum and in 1957, Dr. Donald Wyman gave the hardiest collection the name "Vardar Valley." This boxwood has demonstrated exceptional hardiness and is regarded as almost "ironclad." Again it illustrates the importance of close cooperation between the plant collector and the evaluation sites. In this case, it involved both a public garden and an observant nurseryman.

As soon as World War II was over, the USDA began to send collectors back to foreign countries to gather seed of economic plants but ornamentals were not included. However, Dr. Russell Seibert, Director of Longwood Gardens proposed that ornamental plants not be neglected and suggested that there be a Longwood/USDA plant collecting program to provide for garden plants. Over the next fifteen years, the Longwood/USDA collecting program supported fifteen explorations that covered all parts of the world. The value received by the American nursery industry far exceeded the cost of all of these ornamental explorations and some of the plants collected have become leading cultivars in our gardens.

Japan has been a source of many of th successes from the Longwood/USDA program. For example, in 1956 I collected o the remote island of Yakushima, south o Kyushu. There is an obscure relativ of common crape myrtle growing o Yakushima named *Lagerstroemi fauriei*. It had not been in cultivatio previously and I was fortunate to be abl to locate the tree and collected a smal quantity of seed. It appeared to be a rathe straggly tree in the wild and lacking merit. However, when *L. fauriei* wa grown at the National Arboretum it developed into a handsome specimen with rich brown/orange bark and a fine growth habit. But it was the discovery of resistance to powdery mildew of crape myrtl by Dr. Donald Egolf that made this tree s valuable. Dr. Egolf was able to transfer th resistance through breeding to commo crape myrtle and an entire new breed o mildew resistant crape myrtles ha evolved.

During the same collecting trip, located the southern limit o the Japanese white birc (*Betula platyphylla* va *japonica*) in th

Photo by John Creech

Lysichiton camtschatense *spreads around and through the bog pools of Mt. Hakkoda, Japan.*

Arnold Arboretum

***A horse-drawn cart** being loaded with boxes of seeds outside Frank Meyer's hotel just prior to his departure for the U.S.*

Yatsugatake Mountains. The seed went to the Glenn Dale Plant Introduction Station and seedlings were distributed to arboretums and experimental stations. Most birch trees eventually succumb to the bronze birch borer but the trees of this introduction remained free in the test plantings of the University of Wisconsin Landscape Arboretum over the next 25 years. As a result of its freedom from borers, this introduction was named 'Whitespire' and distributed to the nursery industry.

Among the other yields from Longwood/USDA trips to Japan are azaleas particularly useful for breeding and also direct garden use. At least one newly introduced camellia species, *Camellia luchuensis*, from Okinawa was used to develop a new race of camellias and a broad array of wild types of *Camellia japonica* was provided to breeders. The 'Emerald Sea' selection of *Juniperus conferta* from northern Honshu has become a useful groundcover for coastal areas and sandy soils. There has been a longstanding interest and use of *Aucuba japonica* as a garden shrub where it is hardy. In northern Japan we collected a dwarf form of *A. japonica* called variety *borealis*. It is covered by snow in winter that provides the protection necessary for it to survive in the harsh Hokkaido climate. In cultivation, *borealis* maintains its dwarf stature and is a particularly useful plant for tops of walls and along rustic paths.

The Longwood Gardens program has supported explorations to Nepal where a new cotoneaster 'Emerald Spray' was obtained, as well as seeds of many rare trees and shrubs. The collecting trip to Taiwan resulted in new introductions of *Rhododendron pseudochrysanthum*, azaleas, pieris, and junipers. From the Soviet Union, a new red form of lotus from the Volga River is now called *Nelumbo nucifera* var. *Caspicum* and being offered by water lily specialists.

The exploration to New Guinea by Harold Winters and Joe Higgins provided the New Guinea Impatiens which in the span of only a few years has become one of the leading plants in the bedding plant industry. The trips to Europe by Dr. Fred Meyer provided the great array of variegated coleus varieties that revived their use in gardens. In addition, hundreds of cultivars came from Europe from Dr. Meyer's collecting trips that had been held in European gardens and nurseries during the long war years.

The collecting trips to Australia, South America and again to the Soviet Union in their turn provided new plants for our gardens and added to the range of materials available for plant improvers. We are still searching for "new" plants among the old areas of collecting.

For example, in Japan there is a handsome small flowering cherry species, *Prunus incisa*, that we are only now beginning to appreciate as one of the most important breeding species in the background of our cultivated flowering cherries. Now, Roland Jefferson of the National Arboretum is searching Japan for populations of it and other cherries as a resource for developing new and exciting flowering cherries for our gardens.

Collectors are returning to China and Korea realizing that, while others have combed their regions before, we have the experience of their searches and the living results to base field activities upon. Collectors now are aware that there is a broad base of variability still to be collected and that by adding to the diversity of germplasm available to ornamental plant breeders, improvements that will provide better plants and new delights for the garden are in store.

The plant collector and his counterpart breeder/evaluator are an essential team without which the nurseryman, landscape architect, homeowner, and others who enjoy the fruits of nature would be considerably less well off. At the same time, it is these men who roam the wilderness areas who still spark the romance of the grand period of plant collecting when giants of horticulture journeyed through the hills of China in search of new plants.

Plants that Merit Attention

BY JANET M. POOR

It is indeed a privilege and a pleasure to be able to share in the celebration of this significant milestone with you—The 75th Anniversary of the Brooklyn Botanic Garden; a garden that has enriched the horticultural world far and wide; a garden whose programs and publications have enlightened young and old, amateur and professional; a garden whose beauty and fascination has attracted hundreds of thousands of delighted visitors; a garden whose superb collection of trees most certainly merits attention.

I would like to share with you several quotes which I believe are pertinent to the topic of trees that merit attention.

First from the pen of great renaissance man—the knowledgeable gardener—Thomas Jefferson: "The greatest service which can be rendered to any country is to add a useful tree to its culture."

An old Chinese proverb says: "He who plants trees thinks of others besides himself."

And in the words of Andreas Feininger: "Man's life, his origin, his uniqueness and perhaps even the continuation of his very existence, are inextricably tied to the life of trees—

"Had there been no trees, it seems more than likely that the human race would never have come into being; should the trees die, it is not inconceivable that man, too, would become extinct.

"These are sweeping statements. But the findings of pre-history, history and science—and in particular paleontology, archeology, anthropology, comparative anatomy—by now add up to such an impressive body of supporting evidence that these statements can no longer be doubted."

The greatest threat to the continued existence of the world's tree population is not fire, it is not timber felling, nor even the clearance of land for farming or development projects. The greatest danger, the greatest threat is the indifference

Acer miyabei has exquisite foliage.

Janet M. Poor is editor of *Plants That Merit Attention, Volume I—Trees*, a Garden Club of America book. Mrs. Poor is an active member of GCA and a practicing landscape designer.

of the people—our own indifference.

As enlightened horticulturists and gardeners, you are aware of the great value of trees. We are appreciative of their beauty—how they provide us with a magnificent shade canopy—how they stretch their roots and cling to the soil and help to prevent soil erosion—how they cleanse the air of pollution.

A tree in front of a house can produce a cooling effect equivalent to that of 10 room air conditioners running 20 hours a day. A properly sited tree can reduce summer temperatures by 20 percent.

Trees are the best dust mops on earth, catching much of the 12 million tons of pollutants released into the atmosphere annually. Twenty trees offset the polluting effects of one car driven 60 miles.

Trees can cut noise levels by as much as 75 percent. A 100-foot strip of trees absorbs six to eight decibels.

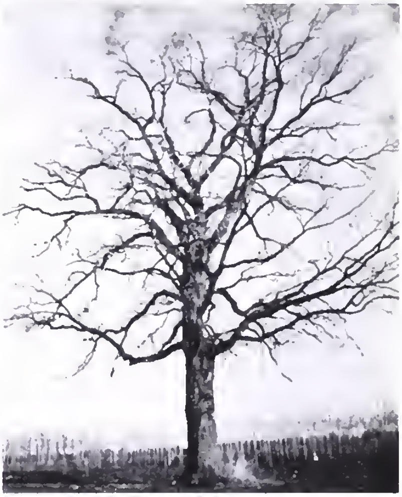
Trees not only make people healthier and happier, they actually keep us alive. Each person in this room needs seven trees to change his or her carbon dioxide into oxygen.

Trees are a resource we know we must preserve! And I think most of us are cognizant of this unique, this invaluable resource.

So, let us address ourselves to diversity in the plant world—more specifically, the world of trees.

Photos by Janet Poor

***Abies concolor** left and above, provides an interesting blue-green color contrast.*



***Quercus macrocarpa.** The branching pattern adds architectural beauty to the winter sky.*

Malus 'Donald Wyman,' *right and below. Flowers, fruit and warm-green foliage make this one of the best.*

Why is there a need for diversity?

The first thought we have is an aesthetic one—and it is indeed important to have our gardens enhanced aesthetically by a wide variety of trees, shrubs and ground covers. But let us take this need a step further. We need diversity to ensure a green environment for our cities, our towns, our villages.

Mass planting—that is, planting many of one variety, can be extremely effective. It is attractive to see a long avenue, a boulevard lined with a dominant tree (one kind of tree). It emphasizes the pyramidal, the columnar, the round effect. But can we afford this aesthetic planting? Of the 600,000 trees lining the streets of New York, over one-half are Sycamore trees—and these have become victims of a pair of fungal diseases.

And another one of many examples: Two tree towns in Illinois—Lombard and Elmhurst—no longer have the miles of majestic trees and shaded streets that give them their names. Lombard, which as late as 1960 had 15,000 Elms, has only 200 of the stately trees now. In Elmhurst there were 20,000 Elms in 1976; now there are fewer than 8,000.

University of Illinois Campus: Not too many years ago the majestic, vase-shaped American Elms were the silent sentinels—guarding, shading, enhancing the campus. I need not describe the sad plight of the American Elm. We know that story only too well. When the elms were gone, the University fathers looked around for a tree that would withstand the rigors of climate and campus and they decided to plant the Honey Locust *(Gleditsia triacanthos)*. Then along came the web worm to southern Illinois.

Because of a monoculture and unwise planting, many other examples of this unfortunate state could be cited. But over and above the pests and diseases which take their vast toll, trees have been felled to make space for gas stations, supermarkets. The asphalt and cement are the dominant features. We lose more than a million acres of green plants annually to asphalt and cement. Many experts think we are losing our fight to keep the United States from becoming a man-made desert. Such thoughtless destruction of trees is prevalent all over the world—and we are the losers.

How can we begin to appreciate the value of a century-old tree? Perhaps the only living witness of the Civil War, the American Revolution.

We have little control over whether or where our cities grow—but we can certainly put our finger on how they grow. And most of us are vitally concerned about the appearance of our

Cercidiphyllum japonicum *leaf, above, purple-bronze in spring, turns green in summer.*

C. japonicum, *near left, a tree valued for multiple trunks.*

Acer griseum, *far left. Exfoliating bark creates interest.*

immediate villages, as well as our major metropolises.

There's too much asphalt and cement out there. We need to plant, but it is imperative that we plant with wisdom. As Ernest Henry Wilson said way back in the 1930s, "There is nothing more laudable than a tree, except to plant two trees, provided the right kind of tree is planted. And to plant the right kind of tree, we need to have a wide variety of trees from which to choose."

I hope we have established clearly in our minds that we cannot afford a monoculture—that we do indeed need a diversity of plantings.

We must ask ourselves: Why is there a lack of diversity? Why does this situation exist?

1) Many of the desirable old genera are fading into oblivion. Examples: Viburnums, Lilacs, grand old Oaks found in grandmother's garden often are no longer readily available in the trade. There are worthy specimens in botanical gardens and arboreta—of which they are extremely proud. But to have a grand old, unique tree in the back of an arboretum doesn't solve the problem. We must make it our mission to share these trees—to get them out into the limelight, to make them known, to make them available in the nurseries.

2) Also, there is a lack of diversity because the outstanding, newer hybrids are scarce since they are little known.

3) It's a vicious circle. The homeowner, gardener often would like to plant an unusual, attractive tree but does not know what to ask for: the landscape architect, designer, contractor often would like to plant a little known, superior tree, but knows that it is not readily available. To continue this vicious circle, the nurseryman is growing trees for which there is a demand. He is in business for economic reasons and logically is offering the plants that sell.

What can we do about these unfortunate, unproductive situations? We can:

1) Indentify and bring these unusual plants to the foreground.

2) Observe their growing conditions, their culture, their origin, how they perform in our gardens.

3) Locate their sources.

We need to enlighten the public.

Seeing this great need four years ago, The Garden Club of America initiated a project entitled "Plants That Merit Attention," Timber Press, P.O. Box 1631, Beaverton, Or., 97075. (Also available by mail from The Garden Shop at BBG.) This project, culminating in a book illustrating 143 worthy trees, is the result of a worldwide search for little known trees with superior characteristics.

The authorship of this book is unique. Hundreds contributed to this publication. In addition to the participation of Garden Club of America Members, others who played an important role in the initial selection process and contributed invaluable information and photographs were horticulturists, botanists, taxonomists, dendrologists, nurserymen and landscape architects. These interested and supportive individuals from all around the world are dedicated to preserving diversity in the plant world.

It is hoped that the selection of trees for this book, which includes their sources, will turn the attention of nurserymen, landscape architects and homeowners to a wider diversity of trees for city and suburb than is now available, and will ultimately enhance the environmental quality of the places where people work, play and live.

Before we see some examples of these trees, may I reiterate:

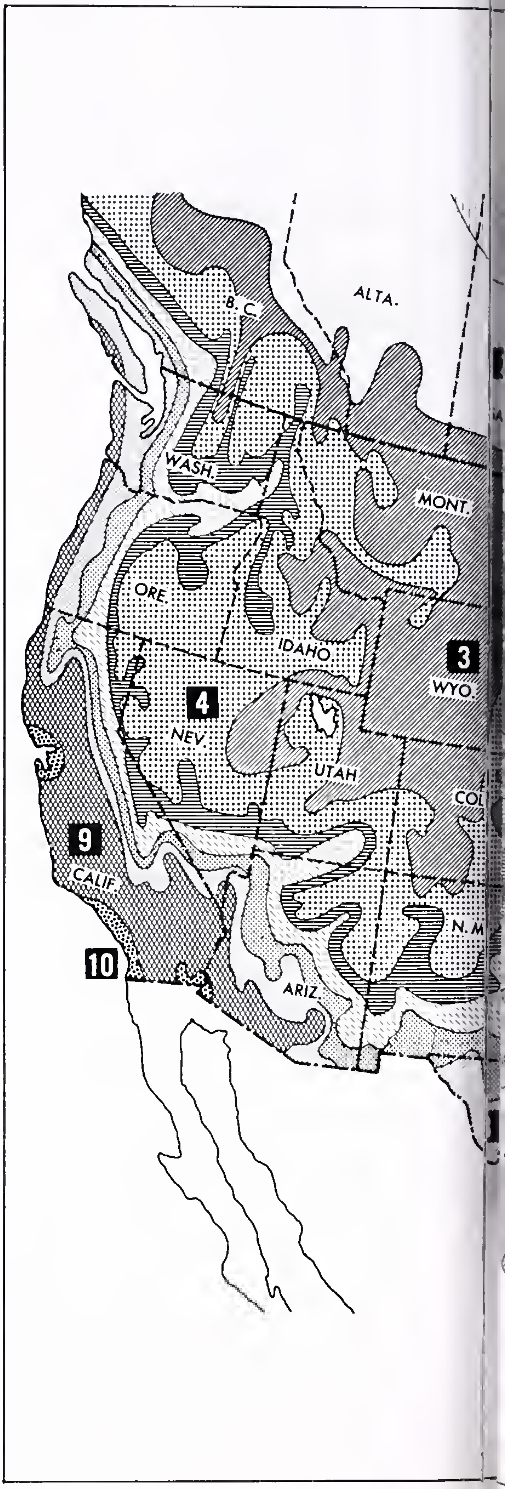
What is a P.M.A.?

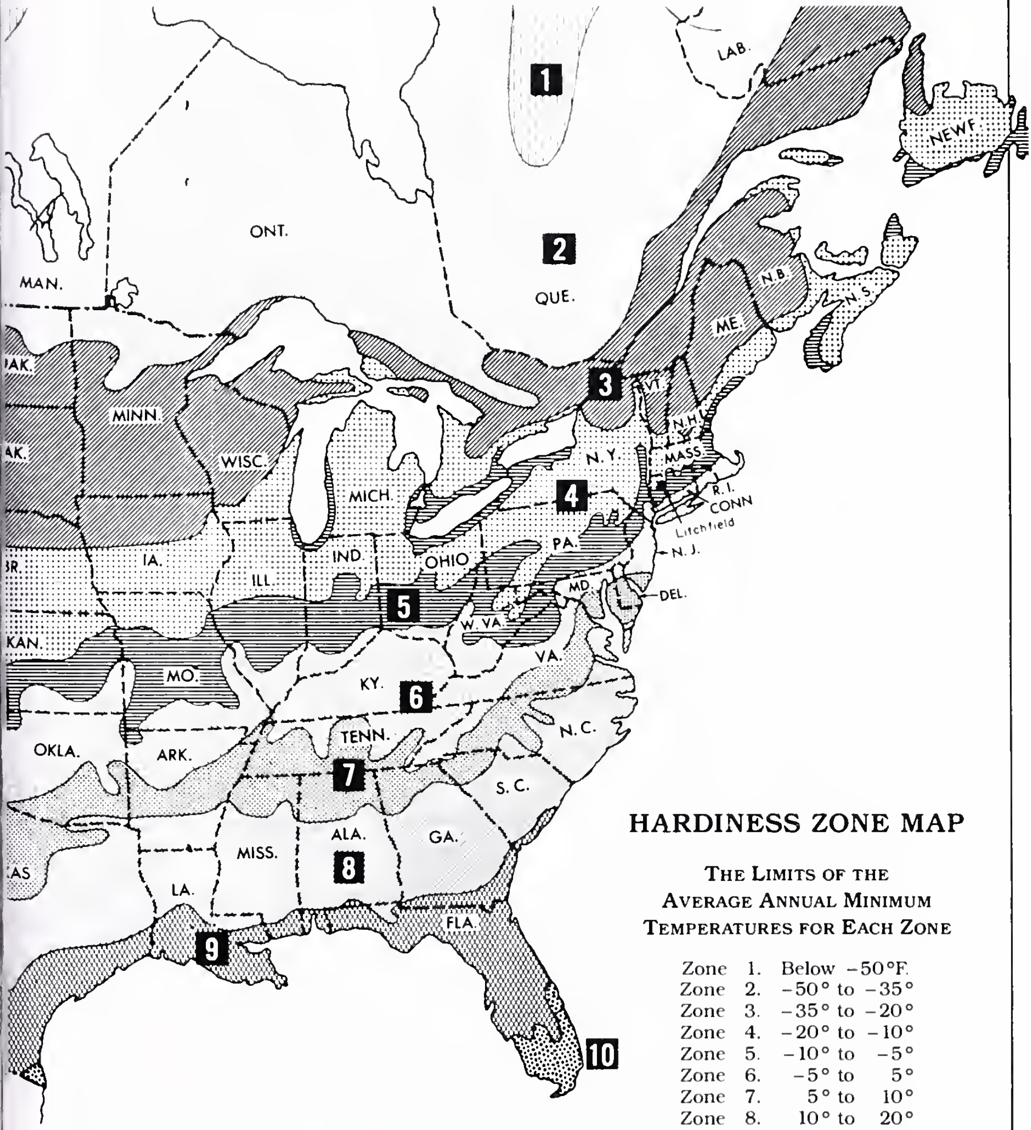
1) Unusual.

2) Not readily available in at least one major region of the United States where the climate is favorable for its growth.

3) But more—must have aesthetic qualities, such as outstanding foliage, flowers, fruit, bark, habit, fall color, winter interest.

4) In addition—if plant has other attributes (A) Insect and disease resistance (B) Tolerance of clay, wide range of soils (C) Environmentally tolerant, it becomes a four-star P.M.A..





HARDINESS ZONE MAP

The Limits of the Average Annual Minimum Temperatures for Each Zone

Zone 1.	Below −50°F.
Zone 2.	−50° to −35°
Zone 3.	−35° to −20°
Zone 4.	−20° to −10°
Zone 5.	−10° to −5°
Zone 6.	−5° to 5°
Zone 7.	5° to 10°
Zone 8.	10° to 20°
Zone 9.	20° to 30°
Zone 10.	30° to 40°

Compiled by The Arnold Arboretum,
Harvard University

Abies concolor **Zones 3–7**

Colorado
or White Fir
Mature height: 30–50′

Wide adaptability. Withstands heat and drought better than most firs. Tolerates sun, light shade and some city conditions. Dislikes heavy clay. Growth habit forms a softer-looking tree than spruces. Blue-green color contrast.

Acer campestre **Zones 5–9**

Hedge Maple
Mature height: 35′
slow growth

Best maple for dry, alkaline soils. Good, hardy, round-headed tree; easily shaped; responds well to shearing. Excellent hedge. Some hedges near Vienna form walls 35′ high. Potential street tree.

Acer griseum **Zones 5–7**

Paperbark Maple
Mature height: 20–40′
slow growth

Tolerates sun, shade. Does not tolerate drought. One of the most beautiful small trees. Stays in control. Vibrant fall color. Last of the trifoliate maples to color. Exquisite bark—exfoliating. Bark against snow is spectacular sight.

Acer miyabei **Zones 5–7**

Miyabe Maple
Mature height: 40–50′
moderate growth

Discovery in Yezo, Japan, C.S. Sargent, 1892. Durable, long-lived, medium-sized tree. Tolerates sun, shade; moderately drought-tolerant.

***Aesculus* x *carnea* 'Briotii'** **Zones 5–8**

Red Horse chestnut
Mature height: 30–50′
medium growth

Spectacular ornamental. Introduced from seed grown in Trianon, France, 1858. Valued for dark-green foliage. Less susceptible to leaf-scorch than common horse chestnut, *Aesculus hippocastanum*. Scarlet flowers in panicles 8″ long, ¾″ wide; brilliant display in spring. One of the most popular trees in England.

Asimina triloba **Zones 3–8**

Pawpaw
Mature height:
15–30′ to 40′

Tolerant of soggy soil. Performs well in full sun or heavy shade. Neglected American native tree. Exhibits handsome foliage, interesting flowers. Adaptable to wide range of growing conditions. In addition, delicious fruit—higher in unsaturated fats, proteins, carbohydrates than apples, peaches, grapes. Contains high levels of amino acids, vitamins A and C, potassium, phosphorus, magnesium, sulfur, iron.

Betula platyphylla japonica 'Whitespire' — **Zones 4–7**

Whitespire Japanese Birch Mature height: 40′ mod. fast growth	Valued for: tolerance of extremes (−30 to 120 degrees F.), resistance to bronze birch borer. Dr. Creech, 1957, collected seed from a native stand in Japan. Seed has been distributed annually to several nurseries for seven years; consequently, liners have been widely distributed throughout the country. Introduced in 1983 by Dr. E. Hasselkus, Univ. of Wisconsin.

Carpinus caroliniana — **Zones 3–9**

American Hornbeam Mature height: 35′ slow growth	Tolerates sun, shade. Does well in heavy shade as an understory tree. Tolerant of wet conditions. Handsome specimen, long-lived, muscular trunk. Grows in wide temperature range.

Cercidiphyllum japonicum — **Zones 5–8**

Katsura Tree Mature height: 60–100′ med.–fast growth	Sun, shade. Tolerant of wind but not drought. Needs supplementary water. Gypsy moth has no interest in this tree. Handsome tree of great distinction.

Cercis canadensis f. _alba_ — **Zones 4–9**

White Redbud Mature height: 35′ medium growth	Sun, shade. Wide pH range. Good understory tree. Attractive, graceful.

Chionanthus virginicus — **Zones 5–9**

White Fringe Tree Mature height: 12–20′ slow growth	Sun. Not tolerant of drought. Will tolerate wide pH range and air pollution. One of the most beautiful and striking of North American specimen trees. Dark-blue fruit, interesting in late summer and attractive to birds. Needs little maintenance—tolerates city conditions. No tree comparable in flower except its Asian relation, _C. retusus_.

Cladrastis lutea — **Zones 4–8**

Yellowwood Mature height: 50′	Sun. Shunned by gypsy moth. Some authorities consider it the foremost American flowering tree. White, fragrant flowers, 1″ long in pendant panicles to 15″. June bloom.

Cornus kousa **Zones 5–8**

Kousa Dogwood Mature height: 20–30′	Flower buds more cold-hardy than *C. florida*. Blooms early summer. True flower inconspicuous—button ⅜″ diameter. White bracts showy part of inflorescence; 4-taper-pointed bracts. 1–2″ long. Raspberrylike drupe Aug.–Oct.—decorative and edible. Sun, partial shade.

Davidia involucrata **Zones 6–8**

Dove Tree Mature height: 20–40′ (40–65′ in wild)	Discovered by French missionary Armand David in 1869. Introduced by E.H. Wilson in 1904. Prefers light shade; will tolerate sun if kept moist. One of the most handsome flowering trees. Should be planted as a specimen. Conspicuous, large, white, unequal bracts have been likened to handkerchiefs. Wilson considered it to be "the most interesting and beautiful of all trees of the North temperate flora."

Evodia danielii **Zones 5–8**

Korean Evodia, Bebe Tree Mature height: 30–50′	Introduced to Arnold Arboretum in 1905 by E.H. Wilson. Sun; will tolerate drought and some air pollution. Subject to damage by ice and wind. Attractive small tree for home garden. Dark, lustrous foliage attractive all summer; late, showy flowers borne in large quantities. Highly ornamental when few other trees in bloom: July–August.

Franklinia alatamaha **Zones 5–8**

Franklin Tree Mature height: 10–20′ to 30′ in southern U.S.	Sun, partial shade. Transplanting difficult because of fibrous roots. Move when young in container or balled and burlapped. Highly ornamental specimen. Fragrant blossoms, resembling camellias, borne over long period in late summer. Discovered by John Bartram in 1765 at mouth of Altamaha River in Georgia. All known specimens today are direct descendants of those collected by Bartram and planted in his name in Philadelphia. He named tree for Benjamin Franklin and river near which he found it growing.

Gymnocladus dioicus **Zones 4–8**

Kentucky Coffee Tree Mature height: 60–100′	Will adapt to wide range of growing conditions. Bold architectural habit creates an attractive tree that has been neglected in the landscape. Beautiful foliage in summer. Handsome, textured, gray bark, stubby branches create distinctive winter interest. Tolerates severe climates and city conditions. Excellent, tough tree for parks, golf courses.

***Halesia monticola* 'Rosea'** **Zones 5–9**

Mountain Silver Bell Mature height: 30–80′, sometimes 100′	Graceful, refined tree with bell-like flowers pendulous on branches. Decorative in spring, as it flowers before leaves. Good urban tree. Grows in sun, shade.

Ilex pedunculosa	**Zones 5–8**
Long-Stalk Holly Mature height: 25–30′	Interesting, handsome, small tree with beautiful, smooth, lustrous, dark-green leaves and long-stalked, bright-red berries. Branching habit not quite as dense as other hollies; thus its form seems more graceful. Full sun to light shade.

Kalopanax pictus	**Zones 5–7**
Castor-Aralia Mature height: 40–60′ (80–90′ in wild)	Elegant, large shade tree. Pest and disease resistant. Hardy, trouble-free. Tropical-looking foliage. Flowers enjoyed by bees. Long-lived. Tolerates alkaline and dry soils when established.

Koelreuteria paniculata	**Zones 5–9**
Golden Rain Tree Mature height: 30–40′	Excellent, small lawn or patio tree. Adaptable to diverse soils and environmental stresses. Good street tree. 8–14″ long clusters of small, showy, yellow flowers in June in South and in summer in northern states. Attractive, bladderlike, greenish capsules—turn brown and persist into winter. Note: Cv. 'September' blooms month later.

Magnolia acuminata	**Zones 4–9**
Cucumber Tree Mature height: 60–90′	Specimen tree; mature trees have gracious, spreading branches. Does not look well when restrained by pruning, so should be used where it can develop naturally. Excellent tree for golf courses, parks, large estates. One of the fastest growing magnolias. Flowers: 3″ yellow-green, erect, bell-shaped, slightly fragrant.

Malus 'Adams'	**Zones 5–8**
Adams Crabapple Mature height: 20–25′	When a crabapple is being chosen on the basis of red flowers, 'Adams' should be considered at the top of the list. Few red crabs resistant to disease; 'Adams' is resistant to scab, fire blight and cedar-apple rust. Spectacular in flower and fruit.

Malus hupehensis	**Zones 4–8**
Tea Crabapple Mature height: 20–25′	Superlative tree, not surpassed by new or hybrid crabapples. Long-reaching branches spreading up and out from trunk. Flowers produced on spurs up and down entire length of trunk. Fruit usually abundant. Introduced in 1900 by E.H. Wilson for Veitch Nursery, England.

***Malus* 'Mary Potter'** **Zones 5–8**

Mary Potter Crabapple Mature height: 10–15′	Excellent small tree where shrubby form and crabapple larger than *M. sargentii* is desired. Valued for: attractive shape, disease tolerance, annual masses of bloom and fruit, as well as post-frost color.

Metasequoia glyptostroboides **Zones 5–8**

Dawn Redwood Mature height: 70–115′ very fast growth	Deciduous conifer. Graceful ornamental that seldom requires pruning. Well suited to parks, golf courses. Light-green feathery foliage. Species has been growing and reproducing itself for 50 million years. Part of landscape at time of dinosaurs. In 1944, Arnold Arboretum provided grant to collect seeds from wild specimens discovered in China. Seeds then distributed by Arnold to arboreta around world.

Nyssa sylvatica **Zones 4–9**

Sour Gum Mature height: 25–30′ (up to 100′ in wild)	Superior, outstanding tree because of right-angle branching pattern, vibrant autumn coloring. Excellent for naturalized areas as a specimen.

Oxydendrum arboreum **Zones 5–8**

Sourwood, Sorrel Tree Mature height: 40′ slow growing	Graceful tree with rounded top and drooping branches. Bell-shaped, creamy-white flowers. Hanging panicles 7–10″. Brilliant scarlet-to-plum autumn color.

Phellodendron amurense **Zones 3–7**

Amur or Chinese Cork Tree Mature height: 30–45′	Handsome, tough, small shade tree. Lustrous, dark-green leaves. Unique and beautiful oaklike bark; broad, spreading habit. Once considered a good city tree, but may not be as tolerant as believed. (Example: specimen in courtyard in St. Bartholomew's Church, New York). Fruit: berrylike, 5-seeded pods on female trees.

Pinus bungeana **Zones 5–8**

Lacebark Pine Mature height: 20–45′ to 80′	Discovered by Dr. A.A. von Bunge in a temple garden near Peking in 1831. Hardy, slow-growing evergreen; needles stiff, sharp, 4″ long in fascicles of 3, light-green with stomatic lines on both sides. Spectacular bark, exfoliating in irregular plates.

Pinus cembra **Zones 3–7**

Swiss Stone Pine
Mature height:
35–40′ to 100′
slow growth

Well-proportioned, hardy pine. Dense habit. Useful in small-scale gardens and formal landscapes. Full sun. Tolerant of wind.

Pterostyrax hispida **Zones 5–7**

Epaulette Tree
Mature height: 50′
mod. growth

Handsome, unusual, tear-drop form. Grows in full sun. Flowers: creamy-white in large panicles 9″ long, 4″ wide, fragrant. Tolerates wind, drought and environmental stress.

Pyrus ussuriensis **Zones 4–7**

Ussurian Pear
Mature height: 30–40′

Hardiest of all the pears. Dependable, vigorous, attractive flowering specimen. Least susceptible to fire blight and has capacity to tolerate adverse soils. Long-lived, requires minimal maintenance. Showy flowers with conspicuous white petals in May. Greenish-yellow pome (fruit).

Stewartia pseudocamellia **Zones 5–8**

Japanese Stewartia
Mature height: 30–50′
(60′ in wild)

Handsome, year-round specimen that will enhance any garden in its growing zone. Exfoliating gray-brown to orange bark. Most colorful of Stewartias. Extremely attractive in winter landscape. Beautiful white flowers (2–2½″ diameter) with orange anthers. Specific name refers to resemblance of flowers to those of Camellia.

Syringa reticulata **Zones 4–7**

Japanese Tree Lilac
Mature height: 30′

A lovely flowering tree, especially valued for its late-blooming flowers (May in South, June in New England, July in Midwest). Shiny, dark, cherrylike bark on young trees. Shapely, vigorous habit, large leaves, exquisite, creamy-white flowers make this a distinguished plant. Sun. Tolerates some drought.

You never know when you are a BBG gardener what you'll be asked to do next. About a week after I came here I told Donald Moore I loved it so much I would do anything he asked on behalf of the garden. Filling in today is a lovely thing and I am delighted. Turn out the lights—let's look at the pictures.

I'm going to walk us around the garden—other days, when it was not raining—but first, let's consider water.

A windmill is prominent in the view from my parents' front porch in the Oklahoma Panhandle, something a lot of people are thinking about as an alternative energy source.

I found a rain barrel at the Floriade in Holland. Add a few goldfish and such a water resource will pose no threat of harboring mosquito larvae.

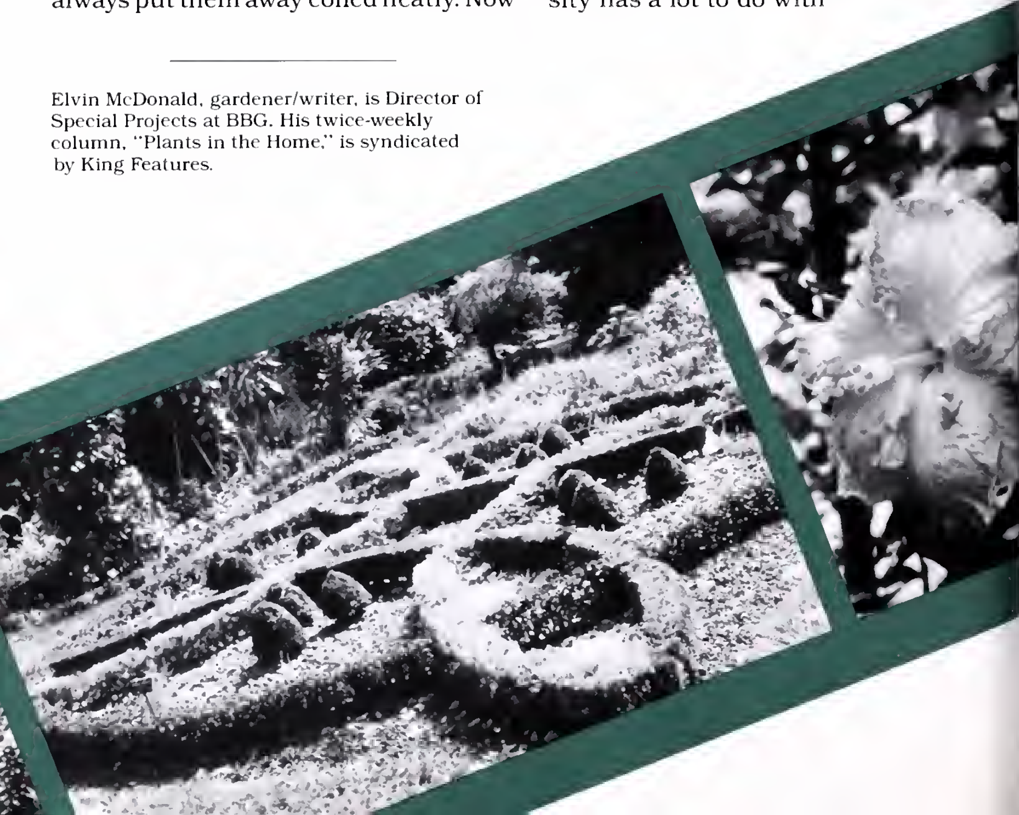
I've been photographing garden hoses all over the world. Maybe someday I'll have an exhibit of garden hoses. I used to say if they were all kinked up and disarrayed that was bad, that you should always put them away coiled neatly. Now philosophically I've come to think that we shouldn't label things as good or bad. The hose is merely snarled and needs a bit of patience from the gardener to unwind it. Maybe the gardener who put it down in knots had to go help save an endangered tree.

In Paris the parks department tosses rolls of burlap tied together with jute on the street to divert streams of water—something we could use at BBG.

Gardeners need rubber boots. My mother always wore them to do her farm chores, but growing up I aspired to New York, where surely smart people did not wear such things.

Gardeners don't really have rainy days. We always have something to do on a rainy day. Planning, looking ahead—or back—at our notes. For the journalist in me, a rainy day means I can reclaim my desk and write until the typewriter smokes.

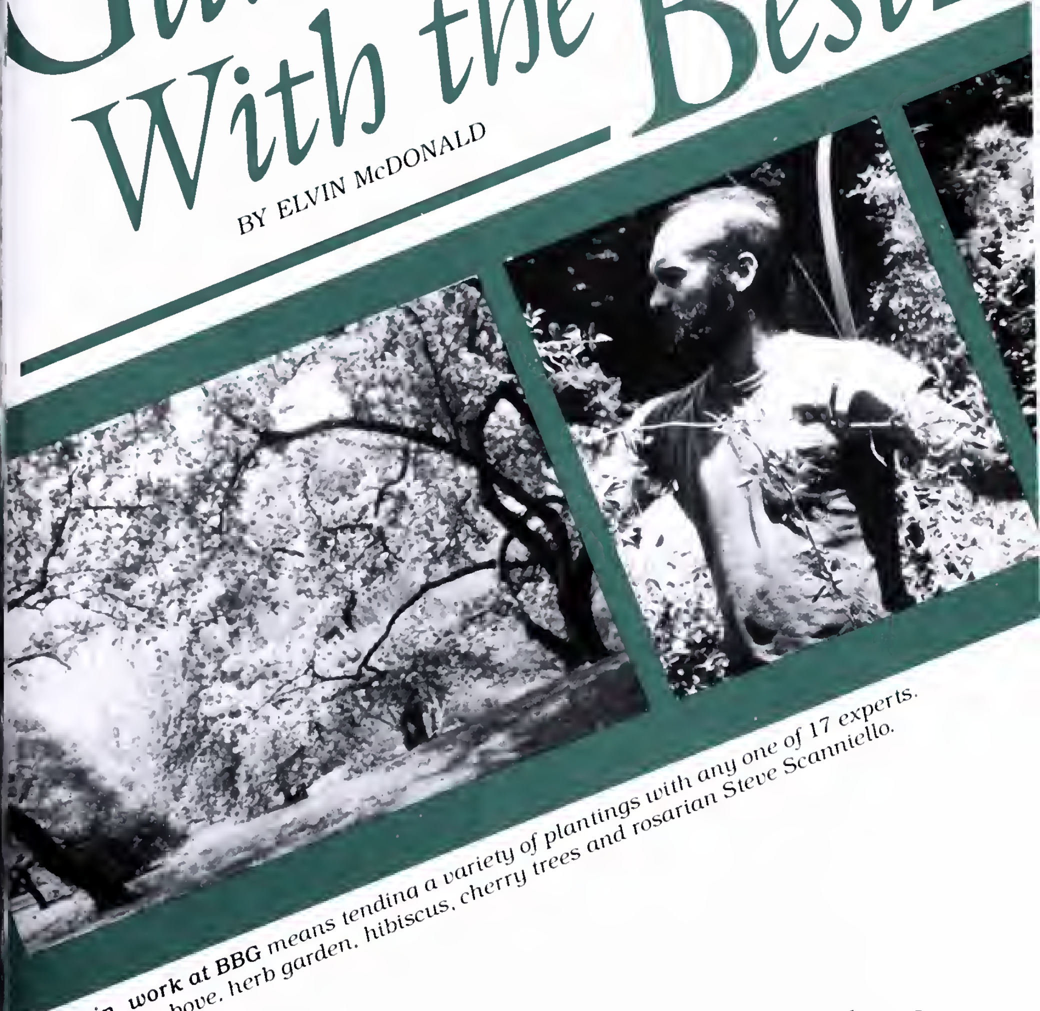
The fact that my youngest child Jeannene is nearing graduation from university has a lot to do with



Elvin McDonald, gardener/writer, is Director of Special Projects at BBG. His twice-weekly column, "Plants in the Home," is syndicated by King Features.

Gardening—With the Best

BY ELVIN McDONALD



For Elvin, work at BBG *means tending a variety of plantings with any one of 17 experts. Left to right, above, herb garden, hibiscus, cherry trees and rosarian Steve Scanniello.*

why I am here in what some might consider a new career. I'm middle-aged and for a few years I've been searching for what to do with the rest of my life, having sort of done everything I ever wanted to do. Then I began to think, maybe there was still life for me in a botanical garden, which had before seemed an impossible dream—credentials you know. I was formally trained to be an opera singer, neither writer nor gardener.

At the New York Flower Show gala preview party this year, I ran into Donald Moore. As I had been meaning to come see him anyway, I just seized the moment and said "Donald, I'd like to work in a garden and I'd like to make some money." The "some" was very important to him, since I didn't say "a lot." Right away he had the idea for me to work a year as if I were a member of the gardeners' union, in order to write a book—a "Plimptonesque" caper, in the manner of George Plimpton and *Paper Lion*. We might even get a musical out of it, because gardeners, at least BBG gardeners, are very funny people. After ten years of being self-employed, I originally thought to go back to work and make enough money to buy property in Connecticut and plant my own garden. Within a few weeks after coming to BBG I realized that was not me: we have plenty of gardens; we need more gardeners. I'd much rather give my life to a public garden than to become introverted into all the goings-on of a private property. Besides, as long as I'm here, I have Donald Moore to pay the bills.

One of the first familiar wild flowers I saw at BBG, blooming out in the perennial border, was ratibida. I had long admired it in my parents' pastures and in the fence rows around wheat fields. All summer I thought it would expire in Brooklyn's humidity and moisture, but the blooms just kept coming. Obviously it is adaptable, which we all have to be.

The signs at the gates say "Welcome to Brooklyn Botanic Garden." One of the perennial discussions in the potting shed is whether or not we should allow people to do certain things in the garden. The more scientific want to keep it a strict botanic garden. Others think we're a park; still others a multimedia mix of music, art, seasonal celebrations and a little horticulture now and again. I'm perhaps in the please-everybody-school, as long as the garden is beautiful and nothing is destroyed. We do ask people to keep their clothes on, and stay out of the beds. BBG gardeners, incidentally, wear working green uniforms—always long pants and

One thing you notice *about gardeners is that they are always stooping. Here Ira Walker does it deftly, without bent knees.*

Shoes are important *to gardeners. Elvin was told to wear steel-tip work boots, but he could barely lift them.*

Photos by Elvin McDonald

nothing less on top than a t-shirt, no matter how hot.

Change: I came here at a time of the most tremendous change in the garden's history. If we don't change, moss will grow on our feet. I've always been inclined to look close up with my camera, but here the pictures are as much for the record as anything—visual notekeeping during the months of the year when I have felt the need to garden fulltime and not to be inside writing. One of the first things I saw in the long shots was how generations of gardeners had loved this Garden and shaped its future—most impressive.

Early in May we have our famous plant sale, sponsored by the Auxiliary. We begin on Monday of that week by working chain-gang fashion—something we don't usually do as gardeners at BBG—moving thousands of flats of plants and individual bonsai, some a hundred years old or more and weighing considerably. Donald Moore asked me, when I had my interview, "Can you lift a bale of peat moss?" Having just moved and dispersed about forty to help install the New York Flower Show, I was confident in saying yes. He didn't ask me about moving two thousand flats of plants in one day. I was tired to the bones that night, but so were the other gardeners. P.S. We had a great time.

Wednesday and Thursday of that week is the actual plant sale, and on Friday what little is left the gardeners clean up. Then we rush back to our posts to continue gardening.

On the first day of the sale, I saw Donald striding through the houseplant tent: "I'm going to town to sign the contract"—which meant we were going ahead with our building program. No surprise, Donald took the subway. The lawyers for the contractors arrived in limousines. That explains Brooklyn Botanic Garden: It is a profoundly democratic—lower-case d—place.

One of the silly fears I had about coming to work here was that Donald had emphasized, "Gardeners must wear steel-toed work shoes." I couldn't find any. I had visions of a drill sergeant stomping on my toes just to be sure they were steel-tip. Instead of my usual run in Central Park, I ran literally all over New York looking. Everyone said there was a great call for them, but nobody had any in stock. Finally, in an army-navy store on Canal Street, I found these boots that weighed so much my worries switched from would I be able to do the gardening expected of me to would I be able to lift my feet.

Every once in a while, at the end of the day, instead of leaving the garden when I clock out, I circulate around and engage visitors in conversations to find out why they come here and what they think about it. Some words they say to me are. . . to find peace. . . serenity. . . beauty. . . to be in fresh air. . . to forget cares. . . to visit with friends. . . read the paper. . . do homework. . . smell the roses. . . .

One thing you notice about gardeners is that we're always stooping over. You really do need a strong back. As part of my spade work getting ready to come to work here, I did a lot of calisthenics, weight-lifting and running. Each afternoon now, while waiting for the subway, I do stretching and limbering exercises. A friend advised against it: "People will think you're nuts and, besides, you'll attract the real crazies." Of course nobody's ever said boo. I got the idea from friends who came home from China enthusing over how the Chinese exercise in the streets. I think we ought to do a lot more of that and it really does help me get all the stored tension out of my neck, shoulders and lower back.

Many years ago I edited a book on espalier gardening, and this has greatly influenced my own work with houseplants. When I came here I was especially interested in the large specimens we have, which are kept in line by our foreman Honorio Ignacio. Philippino by birth, Honorio talks extremely fast: "Hey-guys-let's-go! Come-on-guys-let's-go! "One day when we were lifting a very heavy potted azalea, he innocently gave me some advice that might well be engraved over my personal potting bench: "Careful Elvin, don't over-extend yourself."

A few days before I started here, Barbara Pesch, an old friend from Garden Writers, said to me privately, "Are you sure you're ready for this—the gardeners are a wild and crazy bunch." I wasn't sure, of course, but in fact they're fantastic and we have a lot of fun. Having been a senior editor at *House Beautiful* magazine in an earlier career, I feel the atmosphere here is healthier—everything's more in the open. We joke a lot and no matter if you have a problem, everybody knows about it, and it gets out of the way much more quickly than if you're uptight and secretive.

When Don interviewed me, we were joined by Barbara and Robert Tomson. Don, ever-known for subtlety, asked me right off, "Whose job here do you want?" Perhaps foolishly I said Tomson's, in part because he is only a short distance from retirement as Vice President of Operations. Now, having observed what he has to do all the time, I'm not sure. I think I just wanted to come here and be me, along with everyone else. I don't want to displace anyone. What is so amazing about Bob Tomson is that he always knows which thing to turn to make it work. Almost every day here, we spring a leak or else we're not able to get water. It's always one or the other. Or else somebody pulls a plant—dead or perhaps a weed—and leaves a hole. Anything unfinished invites vandalism so we have to cover up right away.

A monumental amount of cleaning goes on in a public botanical garden. My first day Bernie Currid set me to sweeping Magnolia Plaza. I thought, "This will be nothing. It's a broom. I have a broom at home." And I reach for it. Of course it's not at all like the brooms we use at home. It's an industrial broom. It weighs pounds. The one at home weighs ounces. Before long I had blisters. Later Bernie explained that if I would let the broom do the work I wouldn't get so many blisters.

It's very important to know about gardening tools. The classics have been tried and proven by generations of gardeners; go with the tool, the right tool, and let it swing. Some people work under the curse of Adam; in this frame a weed is more than a plant out of place, it is a curse. Approached this way, with anger, hostility and rigidity, the gardener is sure to wrench muscles or get blisters.

Bernie Currid is the archetypical gardener. Born in Ireland, trained in commercial horticulture in England, he married an American and came to BBG in the late 1960s. He has tremendous responsibilities: all the water gardens, except those inside, the perennial border, the annual border, the herb garden and Magnolia Plaza.

Bernie has a definite plan for each day. First he cruises his areas, picks up any litter, and makes mental notes of what needs doing. When he went on vacation in August, I was put in charge of his gardens. The first Monday out on Magnolia Plaza, there had been some kind of cookout over the weekend. I realize such affairs make money for the garden, but this one left behind a lot of grease stains from the barbecue. I also found two wine glasses, one broken, a pair of glasses, two disposable diapers and a couple of pork chops. I don't know why people don't use the waste cans, somehow more obvious to me and more convenient than the shrubs.

After inspection, Bernie begins the day's real work. On a weekly basis, Friday is for last-minute clean-up. He finds that if the soil in the beds is cultivated, and all the plants neatly staked and cut back or deadheaded they're much less vulnerable to vandalism. In other words, the more respect you show your garden, the more respect others will pay it.

We're inclined to take for granted the ship-shape appearance of a public garden, but in fact truckloads of dead things go out every week. Each Friday at 2 p.m., we stop dead-heading, sawing up branches, and those assigned come around and pick up all the refuse. The branches go one place to be chipped, and everything that can be composted goes to an enormous stockpile. Practically everything is recycled—the chips for mulch, the compost for growing medium. Personally, at death I opt for cremation so my ashes can be scattered here on the compost pile, not to favor any one part of the garden.

BBG's world-famous knot gardens are Bernie's, which he has infused with memories of those he saw at Hampton Court in England. These jewels are ringed by the herb garden with a pungently bracing hedge of Hidcote lavender all along the southern boundary. Here, in my first week, I very neatly cut off the end of my little finger. After a shaky visit to the potting shed for first aid, I returned to my post, now clipping with a new respect for the oldest rule of pruning: Always know where your fingers are.

More recently I've learned another lesson. Exactly one week ago I was in the hospital, having been rushed there by fellow gardeners after I was stung by a couple of dozen yellowjackets. While lopping a maple seedling under a pine tree, I unwittingly evicted the yellowjackets from their nest home in leaf mold beneath ivy ground cover. As I was being injected by an emergency room doctor, he was saying to his staff he could make a lot more money in pharmaceuticals.

My first week Bernie told me ". . .doctors, lawyers and naive optimists in the Education Department at BBG think gardening is fun. Don't believe them. It's work." And besides, he has also observed that gardeners are treated lowly, ". . . like the butler—" and most are paid poorly. Bernie himself dresses up to travel to and from the garden—his lunch in a neatly folded brown paper bag, the only clue he might not be headed for Wall Street.

I wasn't sure Bernie really liked gardening until our fifth day together. Friday at precisely 8 A.M., as we came up into Magnolia Plaza from the nether world of the potting shed, he stopped in his tracks. Since it was the plan for me to get a sense of what it means to be in the shoes of each gardener, I too stopped. In a moment of silence, I realized that he was worship-

Bernie Currid *is in charge of the herb garden, Magnolia Plaza, lily pools, perennial and annual borders. He has a plan for each day. Truckloads of prunings are hauled off weekly.*

ping the beauty that was there and that he really does love gardening--and the Garden. And Bernie does have fun gardening, at home as well as on the job.

The Japanese Hill-and-Pond Garden is the responsibility of Robert Gundacker, a German American who somehow looks quite Japanese. This garden is one of the most artistically demanding of any in the world. Besides the cloud-pruned maples, and a pine that appears to be a great sailing ship about to depart the shore, there are hedges that need shearing nearly every week. Bob's love of the garden is everywhere apparent, but no more than as he walks along the hedges. As an automatic reflex his hands run along them, putting twigs in place, same as a parent pats the head of a child, coaxing errant strands of hair into conformity. Everywhere you look in this garden is a still-life and Gundacker surely knows each branch and pebble. The greeting sign to this garden reads thus, "This is a living, breathing garden/enter its beauty with awe/and let its meaning of life surround you/May your thoughts be as beautiful as what you behold." Signed "Gundacker."

Gardeners are famous for hijinks and one such I have participated in. When a new pond for aquatic plants was installed in the rock garden, goldfish appeared overnight—by miraculous conception during a rainstorm, we told the gardener in charge.

I'm very interested in BBG's iris garden. It has become virus-infected and the plan is to abandon the site, in the process destroying the diseased iris, roots, rhizomes and all. My theory is that weed killers—herbicides—have been used continuously for many years, in the process killing all organisms in the soil, friendly and otherwise, until it is impossible for the irises to fight off viruses.

Also in the annual border, I believe we saw herbicide damage this summer. A pre-emergent is applied after the spring bulbs are removed, before the annual transplants are set. In most cases the damage appeared within weeks, but in some, not for months. The plant simply collapsed for no apparent reason. Some victims appeared to be growing roots above ground, as if to escape toxicity in the soil. There'll be much more about all of this in my book, as I am a staunch believer that healthy plants spring from healthy soil.

Now for some trends in horticulture as I see them—both as a journalist and working gardener. Anything hollyhock is in, and I mean that to include the Malvaceae: Alcea, Althea, Lavatera, Hibiscus and Okra—yes Okra, for in 1986 a new cultivar named 'Blondy' is among All-America Selections (a non-profit organization). Within hollyhocks, for example, I see the need for rust-resistance generally, and specifically for greater emphasis on old-fashioned single-flowered sorts instead of doubles; and for developing a broad color range in the so-called miniature, *Althea zebrina*.

Trend: improved cutlivars. Here again, the Malvaceae provide an excellent example in Chinese hibiscus. The best of today's hybrids are so far superior to most presently on the market that there is hardly any comparison. The improvements are in color, size, flower form, keeping abilities—some last more than one day—dwarf habit, and indoor flowering capabilities.

Trend: organized labor in the garden. When I became Garden Editor of *House Beautiful* magazine in 1967, a national organization for professional gardeners was in the process of being disbanded. All the great estates had disappeared or were about to. Now we see a tremendous resurgence in the need for skilled career gardeners. At BBG, where all gardeners belong to a union, this development has encouraged better educated and more highly motivated individuals, and has turned attitudes from thinking of gardeners as common laborers to regarding them as trained professionals.

Trend: garden fragrance has moved from being a nice bonus to an essential. We are more sensitive to air quality. Fewer of us smoke cigarettes and thus have bet-

Above, *Joyce Van Etten, high atop a ladder, prunes the wisteria in the Fragrance Garden. She's one of two women gardeners at BBG.*

Robert Gundacker, *left, in the Japanese Hill-and-Pond Garden. He uses a generator to power his clippers. Pruning tasks are numerous in this garden and its Gardener-in-Charge surely knows each branch.*

***In springtime Cherry Esplanade** becomes a land of enchantment when the blossoms burst forth in a profusion of pink.*

ter senses of smell. Apart from things that smell good in the garden, we have an unprecedented interest in materials to dry—for potpourri, simmering, or to weave into wreaths and baskets that freshen the air.

Trend: the rank and file gardener is becoming increasingly sophisticated. Consumerism has produced a widespread expectation for truth in labeling; at long last, common names for plants are giving way to a welcoming of correct botanical names. The casual stroller through BBG may not be aware, but the budding gardener desiring to learn is delighted; our plantings are arranged systematically according to botanical relationships: members of the Malvaceae are together, the roses, the conifers, and so on. It makes technical and reference books come to life: BBG is a living laboratory.

Trend: considering the number of women who have over the years been great achievers in horticulture, as gardeners or landscapers, it seems unnecessary to note that it is an area offering great opportunity to women. Nevertheless, Jacqueline Fazio, appointed Gardener at BBG in 1981, was our first. She is now joined by Joyce Van Etten, both of whom do physical labor to equal any male on the staff, and perhaps to exceed a few of us. Presently we share a locker room—but not the rest rooms. In our new facilities, there are locker rooms for each sex, although in my estimation not nearly enough space has been allocated for women in our future.

Gardening like a pro: every day spent with Gundacker has been an education in pruning for me. What I did not realize is that when you climb up into a tree and work there all day, it is tremendously taxing on the foot and leg muscles. You have to come down and walk around every so often, otherwise you get sea legs and may fall out of the tree, or at the very least go wobbling away from the site like a drunken sailor.

Trend: we couldn't run BBG without volunteers. One shining example is Ruth Lutz, a woman in her seventies, who regularly and dependably gives several days a week to the rose garden. She is ready to dig, rake or deadhead promptly at 8 a.m. and never complains. She works steadily until noon, stows her gardening gear in the tool shed and heads for the subway—to Manhattan where she spends after-

***Gardeners are more conservative** these days. If Cherry Esplanade is to remain for the future, dying or diseased trees must be replaced each year.*

noons as a volunteer in the offices of a philanthropic organization.

Trend: we are more conservative, not necessarily politically speaking, but simply as gardeners: we must take the best care possible of what we have. And if we want a cherry esplanade in the future, then we must periodically remove dying or diseased stock and replant with new.

Gardening like a pro: I have spent several weeks of my year in the rose garden, where Stephen Scanniello has recently been made Gardener-in-Charge. His guideline for success is summed up in one word: consistency.

My observation is that rose care is not for the rambunctious. Dealing with roses requires a meditative state, otherwise they will tear the gardener to pieces. My interest in healthy soil has been generously fed here, for the rose garden had been mulched for many years, not cultivated. As a consequence, a serious hardpan developed. After only one season of regular cultivating, we see tremendous renewed vigor among the roses.

Trend: professional gardeners, whether in a botanical garden or a commercial nursery, can be licensed to use pesticides that are too deadly to allow in the hands of the general public. Nevertheless, I sense that the gardeners here are increasingly reticent to apply strong chemicals. Insecticidal soap sprays are used when at all feasible. Anything stronger is used only as a last resort. I have personally learned my lesson the hard way. In my own garden on a weekend, not at BBG, I sprayed malathion for several hours, with a mask, and without covering my arms. As a consequence, I suffered malathion poisoning and was forced to bed for three days.

Gardening like a pro: where weeds are concerned, get the roots and all, otherwise the weed will likely grow again, and you may very well be the gardener sent to extricate it. You may not believe in karma, but where pulling weeds is concerned, I believe it is good karma to get the whole weed, otherwise it will return to taunt you—or the next gardener.

Another time, in my book perhaps, you'll get to know all the other BBG gardeners. Or visit us any day of the year except Mondays when BBG is officially closed—a workday set aside for us to do heavy cleaning and construction projects that could endanger the unsuspecting visitor.

Photos by Nina Bassuk

Stress and Street Trees

BY NINA BASSUK

I would like to share with you what our thinking is on the problems of urban trees; what some of our experimental results are, also what may be possible future solutions.

The Urban Horticulture Institute was funded by the New York State legislature about five-and-a-half years ago, and was the first institute in the country to work specifically on the problems of plants in cities; why do these plants have such a rough time of it, and what can we do about it? The urban aspect of horticulture is a sub-field now gaining international legitimacy as a real science. Of course, most horticulturists have greenhouses, fields or botanic gardens to call their "field plots." The city is my plot. This is where I work and do much of my outdoor research. We made a decision in the Urban Horticulture Institute that we would use our fairly small resources to concentrate on the problems of street trees, which affect the immediate environment of the greatest number of city dwellers.

Unfortunately, trees are a kind of afterthought in cities. I don't have to preach to the converted here, I'm sure, but the amenities that street trees provide for urban dwellers are manifold, if difficult to quantify, in terms of micro-climate, softening of the architectural landscape, shade in the summer, habitats for wildlife, and so on. But what about the trees themselves? I'd like to run through a kind of litany of urban-tree stresses, then look at our experiments and possibilities for

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Nina Bassuk is program leader for Cornell University's Urban Horticulture Institute. Dr. Bassuk, a native New Yorker, is also an assistant professor of horticultural physiology at Cornell.

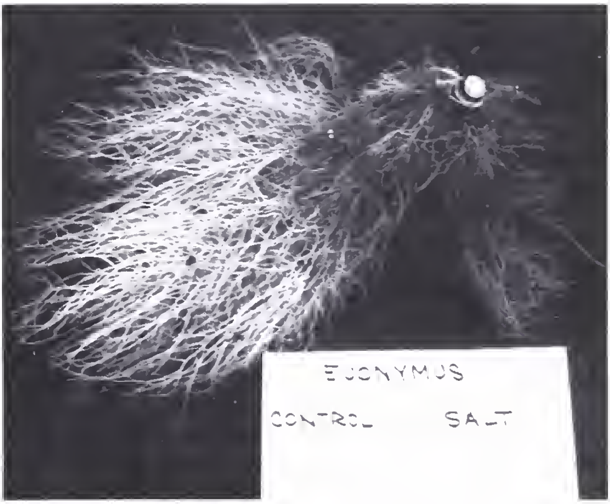
future solutions.

What are the problems? Looking underground first, we find that tree roots may not actually be as unencumbered as a tree's above-ground appearance may suggest. Limiting root growth and expansion are a multitude of underground obstacles, including subways, utility conduits, coal chutes, poor soil conditions and even no soil at all. When digging up street-tree pits, we often find builder's fill or rubble, a combination of wood, glass and metal. Or we may come upon bed springs, tin cans, all sorts of things entangled among the trees' roots. The variety of debris contained in urban soils is simply amazing. In New York we've dug up several dead or dying trees in order to examine their root systems. One thing that was immediately apparent was that root balls often contain a very different soil type than that of the surrounding pit. Sometimes these textural differences prevent roots from getting out of the root ball and into the ambient soil. The trees become "containerized," even though planted in the ground. A further problem is the fact that street trees are normally surrounded at ground level by impervious concrete, allowing just a small opening at the base of their trunks for water seepage.

It's estimated, by the way, that of the thousand or so street trees planted in New York City every year, approximately half will be dead by the time they're ten years old. This is a tremendous loss to the city, both financially and esthetically.

In the best of circumstances, tree roots are not ordinarily very deep. They stay near the surface, in the top twelve-to-eighteen inches of soil, where plenty of oxygen and water are potentially available. But harsh urban conditions—

***Trees in the urban** landscape, upper left and above, provide shade, soften the surround and make wildlife habitats. But they also face difficulties. Growth is restricted by poor soil, underground obstacles, little water.*

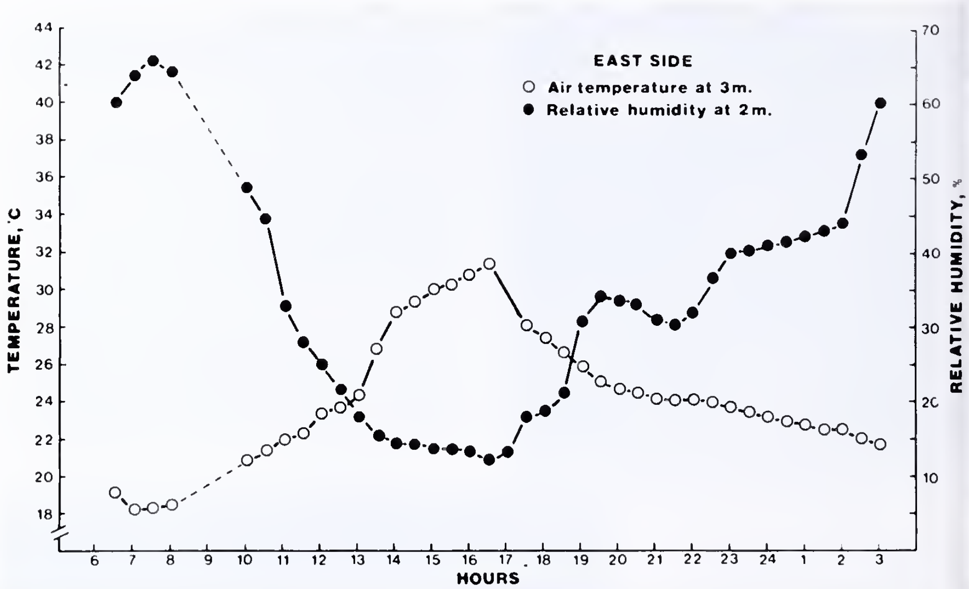


***Comparison** of* Euonymus *roots showing effects of salt. Control sample illustrates healthy roots. Urban streets are heavily salted in winter.*

constant excavation and construction can alter soil environments considerably—restrict the horizontal spread of normal root growth, creating enormous stress and making it nearly impossible for roots to provide a tree with the water, nutrients and firm anchorage it requires. This may explain why so many trees are down in metropolitan areas all along the East Coast right now, in the wake of Hurricane Gloria.

The ultimate example of a stressful root environment is the container. There are many places in the city where it's impossible to plant trees in the ground, so potted specimens are substituted. But this is seldom a permanent solution; many of these trees must be replaced yearly or, at best, within a few years.

In many instances, there are chemical problems with urban soils. Plenty of salt is spread on northern urban streets during the winter, and this can be very detrimental to tree roots and foliage. Another stressful situation is that soils in urban areas often have very high pHs. This is caused, we think, by building materials, such as concrete, which contain limestone, a heavily alkaline substance that will raise pH levels. Certain trees are very susceptible to soil acid/alkaline levels—pin oak and iron chlorosis, for example. Then there's the story of the azalea owner who decided to show off his plants by mulching them with marble chips. We all know, of course, that azaleas are acid-loving plants, and that marble chips contain alkaline calcium carbonate. This leached into the azaleas' soil, raised its pH and two weeks later, the plants died. Environmental stresses are rarely manifested in the immediate death of a tree, however. Rather, its decline is long and agonizing, with the tree looking worse and worse each year. Finally, a pathogen, disease or insect will cause its demise. But the environmental stress was the initial culprit.

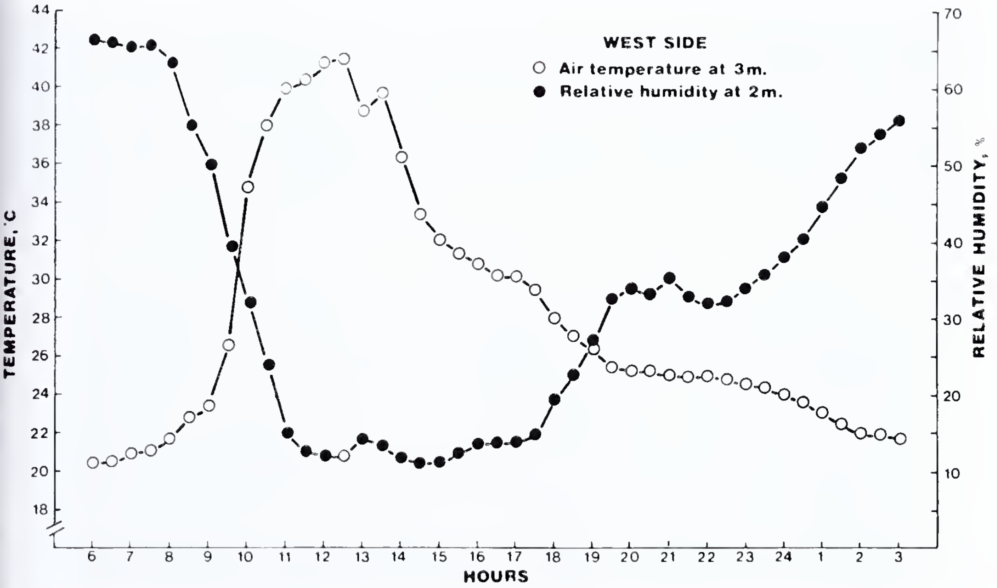


Temperature and relative humidity *measured on the east side of Columbus Avenue varied a great deal from readings in Central Park (due in part to man-made surfaces).*

What about stresses above ground? We know that urban trees are typically planted as isolated units, thereby exposing them on all sides to heat radiation from building and pavement surfaces. Also, tall buildings form canyons that increase the quantity and velocity of the winds to which street trees are subject. So, below ground, we have a limited supply of water, and above ground, where it's hot, dry and windy, we have a heavy and rapid loss of moisture from tree leaves. We have an increased demand combined with a decreased supply, and this equals severe water-shortage stress. The fact that we frequently see symptoms of drought stress in New York City lends credence to this hypothesis. The indications we observe are, first, premature fall coloration and leaf fall, then branch die-back.

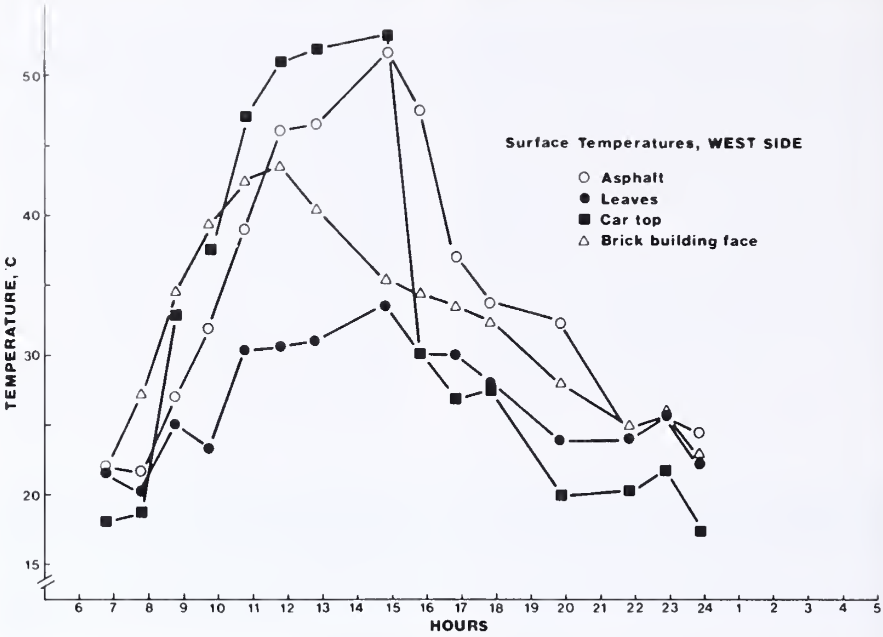
We could have hypothesized all we wanted, however, and it wouldn't have meant anything without concrete, scientific data. So we set up a formal investigation of the street trees in a five-block area of Columbus Avenue on New York's West Side. The site includes approximately half little-leaf lindens and half Marshall's seedless ash. There were twenty-three trees to begin with, but now sixteen, seven having died since we began.

Our objectives were to measure the micro-climate elements affecting these trees and to determine whether or not regular watering could ameliorate the stresses they were experiencing. We set up a weather station on each side, east and west, of the avenue, in such a way that conditions would be measured exactly at tree-canopy height. We weren't concerned with what the official weather report from Central Park—just a few blocks away—was, but what was happening up among the tree branches along Columbus Avenue. We monitored wind speed, relative humidity, air temperature and solar radiation.

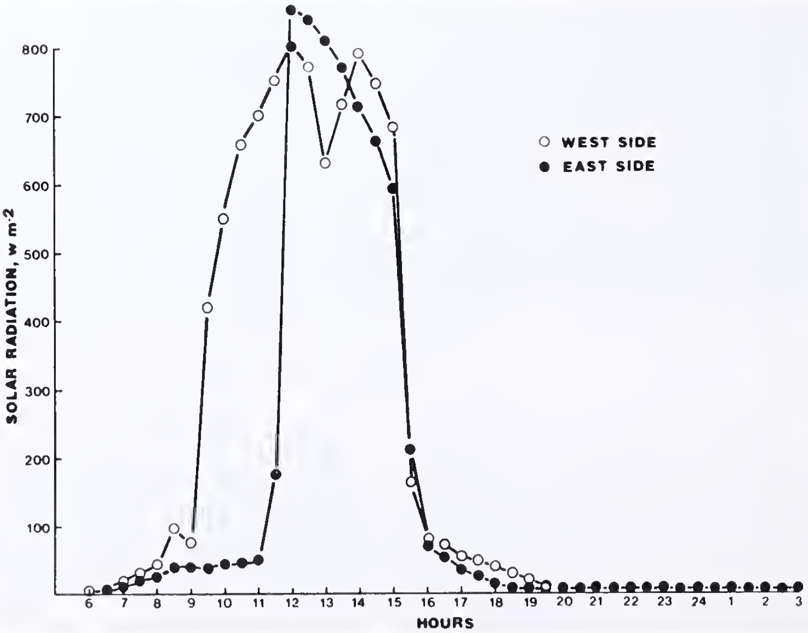


The same measurements taken on the opposite side of Columbus Avenue. The sun "rises" and "sets" at different times because of varying heights of buildings.

Also, the Central Park Conservancy helped us water half the trees. We wanted to see if applying one inch (five gallons) per week to the plants' four-by-four-foot pits would lessen what we supposed was water stress. But the soil was so compacted that it refused to take up the water, and the final solution was to pressure inject it. We succeeded in watering half



Surface temperatures *of the hard materials surrounding the trees varied greatly depending upon what they were made of. Car surfaces heat and cool quickly; asphalt retains heat.*



Solar-radiation measurements *on both sides of Columbus Avenue were similar. Measurements were taken specifically at tree-canopy height.*

the trees once a week for at least a year.

Typcially, we spend one twenty-four-hour period per month during the growing season on Columbus Avenue, monitoring the environment and observing organic processes. We use a porometer to measure the rate at which water is transpired through the leaves. We also assess water potential—the degree of tension with which moisture is held in the tree—the more tension, the more stress the plant is experiencing.

The tall buildings along Columbus Avenue create false horizons, so the amount of direct sunlight the trees receive is considerably less than a full day's worth and it varies from one side of the the avenue to the other. For trees on the west side, for example, the sun might "rise" at nine in the morning and "set" at three-thirty in the afternoon. On one particular day in August on this side of the avenue, we recorded a low temperature of twenty degrees Centigrade and a high of forty-two degrees C. (108 degrees F.). The relative humidity dipped to a low of ten percent. These conditions make me think more of Tucson, Phoenix or Los Angeles than of a maritime, northeastern city. What's really interesting, of course, is to compare these data with the official weather report for that day: a high of eighty-six degrees F. and a low relative humidity of forty percent. In just a few blocks from Central Park, where the official weather was recorded, therefore, we saw a thirty percent drop in humidity and a twenty-two degree rise in temperature.

Furthermore, the east side of the avenue presents a story of its own. You might think it would be a mirror image of the west side, but Columbus Avenue does not run directly north-south, and the east side is in shadow until about eleven-thirty in the morning, and then again at about four in the afternoon. During the same August day on this side, we recorded a high of thirty-two degrees C. (90 degrees F.) and a low relative humidity of about ten percent. Again, compared to Central Park, we have a hotter, drier environment on the street, with the west side considerably more stressful than the east.

What was causing this micro-climate disparity? We hypothesized that it was the result of the man-made surfaces surrounding the tree canopies. We then measured surface temperatures, using an infrared thermometer, and found that they vary tremendously, depending on what they are made of. Car surfaces, for example, get very hot (about 130 degrees F.) during a summer day, but cool off rapidly after sundown. Asphalt, on the other hand, gets just as hot, but because of its extensive mass, holds onto this heat and continues giving it off to the atmosphere during the evening.

What conclusions can we draw from all of these observations? For one thing, we know that we have to provide more space for root expansion. Long, continuous planting beds where street trees would share rooting space would be a vast improvement. These, combined with the use of porous materials for surrounding surfaces, would also allow much greater amounts of water to reach tree roots. Another helpful measure would be to plant trees close together, in groups, so that they would provide each other with shade. And slightly raised planting beds would facilitate water drainage and run-off of salts and other harmful pollutants. Also, we shouldn't stick to lollipop shape, perfectly symmetrical varieties. We can use under-story plants, multi-stemmed trees or those considered "weeds" that might be more tolerant of environmental stresses. We must spend more time selecting and developing trees for their stress-resistant, rather than ornamental, characteristics. We want to increase species diversity to match up tree potential with the limitations of the urban environment.

By combining innovative planting design, astute tree selection and species diversity, we're going to come up with some very effective and attractive solutions. We have lots of opportunities, and I think now with the interest in this work increasing nationally and internationally, we can look forward to healthier, longer lived and more esthetically pleasing city environments.

Perennials: the Grace Notes of the Garden

BY PAMELA J. HARPER

What I've chosen to do today is show you pictures of a number of gardens in which perennials are grown very well, then focus on the particular perennials being grown there. It seemed appropriate to start with the picture on the cover of PERENNIALS: HOW TO SELECT, GROW AND ENJOY*, co-authored by me and Frederick McGourty. What you're looking at is a view of the main border in Fred and Mary Anne McGourty's Norfolk, Connecticut, garden.

In England, if you learn something about plants, it's more or less applicable to the whole of the country. There is some climate variation, but less than one zone, by American standards. And maybe there's some variation in soil alkalinity and acidity, but nothing like the differences we have here. This means that in the United States you cannot learn it all from your own practical experience, which ideally is what I like to do. During many visits to the McGourty garden, I've learned a great deal about how plants fare in a fairly rich soil in the Northeast. Often they behave quite differently from the way they do for me in a sandy soil in Virginia. Fred and I exchange plants, so we've tried out many of the same ones. Frequently, the plants that do particularly well for me do poorly for Fred, and vice versa. Some favorites in the McGourty garden are these:

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*HP Books, Tucson, Arizona

Photos by Pam Harper

***Sir John Thouron's plantings** in Pennsylvania were inspired by the English-style perennial garden.*

Astilbes are at the top of the McGourty list of good plants—but they're hopeless for me in Virginia. I cannot keep them sufficiently moist to compensate for the very hot summers. They must have moisture. They benefit from a bit of shade, but will grow in full sun if the soil is moist enough. *Astilbe* 'Fire' is one of the brightest reds in all of horticulture.

Feverfew, *Chrysanthemum parthenium*, is one of the most important plants for massing and for toning down bright colors. This plant does every bit as well for me as it does for the McGourtys. It's a real survivor, and seems to do well all over the United States—and everywhere in the world, I think. This is not a very long-lived plant, but once you have it established, you'll find plenty of seedlings for transplanting. I've never found it to be a nuisance, though it does seed itself quite vigorously. Feverfew benefits by being cut back by about half when it reaches about two feet in height. This will keep it from sprawling. It blooms through the growing season in Connecticut. In the South it often pauses in July and August, but reblooms in the fall. In another Connecticut garden I'm familiar with, it has seeded into the apothecary rose; it's one of those plants that often looks much better where it chooses to put itself than where you choose to put it.

The other prevalent massing plant in the McGourty garden is *Artemisia schmidtiana* 'Nana.' I still haven't, to my satisfaction, determined whether *Artemisia* 'Silver Mound' is, in fact, *Artemisia schmidtiana* 'Nana.' In gardens in England and on the West coast, artemisias labeled 'Nana' are lower growing than those called 'Silver Mound.' But on the East coast they grow larger, and I'm not sure whether this is the result of climate or the fact that it's a different plant. I'd appreciate input on this question.

Astilbe chinensis 'Pumila' is the most drought resistant of all the astilbes. So if you're in doubt about whether or not you can grow astilbes, make this variety your "canary down the mineshaft." It's one of the smallest, apart from the really minute little rock-garden kinds. It's the only stoloniferous astilbe I know of and it makes an excellent border edging, robust enough to keep the grass out. 'Pumila' spreads rapidly, but is not invasive. It does quite well for me in Virginia, so I had hopes for *A. chinensis* 'Finale.' One of the last of the astilbes to flower, this one has proven to be much less drought resistant

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Pamela J. Harper, author of numerous gardening books, lecturer and photographer, gardened in England before moving to the U.S.

Lychnis coronaria **'Alba'** *is an excellent gray-leaved plant for the border. It combines more readily with other flowers than the bright-pink blooming species.*

than 'Pumila.'

Cimicifuga racemosa always looks good in the McGourty garden, but not in mine. This is another plant that needs a fairly deep, moist soil, and it really prefers a cooler climate than that of coastal Virginia. It is native to the Southeast—but up in the mountains, not along the coast. In my garden, full sunlight scorches it. If I put it in shade, then it either competes with tree roots or leans toward the light. A fine plant for Northeastern gardens, it is one that will stay where it is—probably for your lifetime. It doesn't need to be moved around or divided. This is fortunate because cimicifuga is difficult to divide. This plant requires staking only when it comes into flower. Slender wire supports for individual spikes is the best arrangement. The timing is in contrast to most perennials which, if they require it, must be staked very early in the season.

Coreopsis verticillata does equally well in the Northeast, Southeast, England and just about everywhere else. The best-known form is the bright-yellow 'Golden Shower.' Another is the primrose-yellow 'Moonbeam.' Both spread quite rapidly without being a nuisance, and flower for most of the summer. In my garden, 'Moonbeam' has had to go into the intensive-care unit because voles ate most of the roots before I realized what was happening.

Uncommon hose-in-hose primrose is a real gem. It likes a fairly moist situation. I'm not sure what species it is—probably either a form of the oxlip, *P. elatior*, or of the hybrid between *P. acaulis* and the cowslip, *P. veris*. It is difficult to find in nurseries, but not uncommon in Northeastern gardens. The McGourtys sell it at Hillside Gardens, and you see it occasionally in other Northeastern nurseries, but not in the South.

A common primrose in the Southeast is the one called cowslip primrose. This is a hybrid between primrose and cowslip, and by far the best of the primroses for hot climates. It will tolerate drought, provided it has afternoon shade. It is sterile, or almost so; I've never found a seedling. So it's another of those plants that is handed down from friend to friend. It is actually quite common in gardens, but seldom sold by nurseries. In my garden, I've combined it with *Iris cristata* in an east-facing bed, with azaleas behind. I find it disappointing that the only primroses sold by most nurseries are the colossal Pacific Giant hybrids, which are barely perennials at all, and certainly the least adaptable of all the primroses.

A beautiful example of an English-style perennial garden in the United States is Sir John Thouron's in Pennsylvania. In the middle of one of his borders is a showy geranium, *Geranium psilostemon*, that's just beginning to creep onto nursery lists. Its color is stunning—a brilliant magenta with a dark eye. The *Verbascum* at the back of this border is a fairly short-lived perennial. There are lots of annuals along the front. In order to have color in the garden through the growing season, we cannot dispense with annuals; perennials alone will not do it.

Geranium psilostemon 'Bressingham

Flare' is a new cultivar developed in England. It's one American nursery owners should import and make available here. Its color is attractively soft, and I think this geranium will prove very popular in the future, if given the chance.

Most potentillas are strongly invasive, and many are sprawling plants. One of the best is *Potentilla recta* 'Warrenii.' *P. recta*, itself, can be a nuisance. It seeds prolifically and, in fact, has naturalized in many parts of the country. The deeper yellow 'Warrenii' is never a nuisance, and blooms for a long time. It prefers a soil that's moderately fertile, rather than very rich, and it's fairly drought-resistant, provided it doesn't get absolutely bone-dry. Even nicer, I think, though a little harder to find at present, is *P. recta* 'Sulphurea.'

When I lived in England, I gardened in heavy clay, and was not successful with many gray-foliage plants, which tended to rot in the heavy soil. I thought that when I started gardening in Virginia, I could indulge my passion for these plants, but found that I was wrong. Now they rot because of the hot, muggy summers and considerable rainfall. One that doesn't, however, is *Lychnis coronaria*, the rose mullein. I personally find its bright color difficult to place in the garden. Even toned down by the lovely gray foliage, it still shouts at you. I much prefer *L. c.* 'Alba.' When its flowering is over, cut off the stems, and then you'll have a nice mound of gray, wooly leaves, which won't rot. This plant seeds itself all over the place, and seedlings transplant well if plenty of soil is left on the roots. The rose mulleins are easy to grow from seed, and that's the best way to start them because the wooly foliage doesn't ship well.

Watch out also for *L. coronaria* 'Oculata.' It can be found on plant society seed lists, and is just beginning to get into nursery catalogs. It is white, with an uneven pink eye. Surprisingly, this cultivar takes quite a bit of shade, provided there isn't root competition from trees.

Campanula glomerata is an old-fashioned favorite that grows best in fairly

***Sedum 'Autumn Joy' is one of the very best** of border plants. Most experienced gardeners consider it the choicest sedum.*

wet and heavy soils. But it's somewhat tolerant of other conditions. If you grow it from seed, you'll get tremendous variation—all the way from little buns small enough for the rock garden, to plants two feet or so high. In the border, it combines well with the pink *Achillea millefolium*. *C. glomerata* is a nice plant with attractive foliage, but it spreads fast and needs recorraling every few years.

Sedum 'Autumn Joy' seems to be everyone's favorite perennial—and deservedly. I know of no other perennial that stays attractive longer. I'm watching with great fascination the way the growing of perennials is developing in the United States. So many trends in American gardening started off following English traditions. There is a lot of interest in borders, but we are also seeing other ways of growing perennials. One of these is using perennials in mass. I think this is going to prove better suited than borders to this time and nation. If you think about it, you'll realize that in nature, the things that you really look at and say "Ooh" over, are not the odd little plant here and there, but great quantities of the same plant and big splashes of color. Most English plantsmen find it very difficult to put a hundred of one plant into a space that would hold a hundred different ones. Because plants are used with greater varietal restraint in the U.S., there is a sharper eye for landscape interest. We're going to see this massing effect more and more in the future because it has practical, as well as esthetic, appeal. Most of us care for our own gardens without help, and a hundred plants of the same kind involve much less maintenance than a hundred different kinds.

Planting a rock garden amid steps *is a typically English technique. Plants must be placed in such a way that they will not be trodden upon.*

Sir John Thouron has massed *Sedum kamtschaticum* in the crevices of a stone stairway in his garden for a very pleasing effect. Planting a rock garden amid paths and steps in this manner is a typically English technique. Of course, it would be impractical if these accessways were heavily used; try it only in places where the plants would not be heavily trodden upon.

I keep reading that perennials are popular among gardeners because they're low-maintenance. All I can say is a lot of people are in for a very big shock; perennial borders involve a great deal of work. So there's much to be said for a small garden, and there's no shortage of small plants for the collector who wants a variety of perennials in a small space. My sister's tiny English garden was designed with raised beds, so as to leave ground space for sunbathing. Raised beds are the very best way of getting extra space in a small garden; plants can cascade over the edges of the beds without interfering with paths or recreational space. Compact plants in my sister's garden include campanulas. *Geranium dalmaticum* and *Alchemilla conjuncta* (usually sold as *A. alpina*, which is a less attractive species.)

Strictly speaking, the culinary sages *(Salvia officinalis)* are shrubs, but for practical purposes they fit in more appropriately with perennials. One of the problems I have with salvia in my area is that several inches of rain may fall within 24 hours. Even when the soil is well drained, that much rain—especially during hot weather—rots the sages. I've found it helpful to put a slab of rock over the roots to prevent them from getting soggy during torrential rain. Conversely, this arrangement helps retain moisture during droughts.

Veronica 'Heidekind' is one miniature perennial that can be purchased locally. It grows to about six inches high, with spikes of pink flowers. *Campanula isophylla* can be grown outside in mild climates, but for most American gardens, a hardy substitute is *C. portenschlagiana*, formerly *C. muralis*, and still found under that name in many nursery lists. It is easy to grow. So is *C.* 'Elizabeth Frost' (available from Rakestraw's Gardens) with gray-white, starry flowers on trailing stems. The dark leaves of *Ajuga* 'Multicolor' tend to disappear against the browns of earth or mulch paths. Such dark-leaved plants are much more effective against gray paving.

The tall-growing delphiniums are inappropriate for tiny gardens; they'd be quite out of proportion. But you can grow *Delphinium grandiflorum (D. chinensis)*, which is easier to grow than the tall *D. elatum* hybrids. Also appropriate for small gardens are plants that might be considered too invasive for large gardens. This is contrary to the usual recommendations in gardening books. But in a small garden, you can be aware of an invasive plant and keep it in check. In a large garden, on the other hand, you tend to be busy with too many things. Before you know it, a spreading variety has taken over. One of the most beautiful foliage plants available, *Houttuynia cordata*, is also one of the most invasive, so be careful where you put it.

Phlox 'Precious Pink,' one of the creeping phloxes, originated in the U.S.—probably at the Fosters' garden, Millstream, in Connecticut. This is a lovely plant for the edges of paths or raised beds—wherever its flowing and cascading nature can best be made use of. It's very important in a small garden not to have too many plants looking shabby for a large part of the year. In my sister's garden, the emphasis is on plants that are evergreen or have attractive foliage for much of the year. Any that go dormant go quickly and neatly, not looking unkempt for any great period of time.

Geranium sanguineum is one of the very best hardy geraniums for gardens all over the country. *G. sanguineum lancastrense* (frequently listed incorrectly in the United States as *G. s. prostratum)* and *G. s. album* are also very easy to care for. The white is looser in habit than the pink and the purple. *G.* 'Ballerina' isn't as easy to grow. It needs a rock garden or a place where you can give it rather close attention.

Aurinia saxatilis 'Dudley Neville Variegated' is a really beautiful foliage plant. Its flowers are a biscuity color, but the white variegation of the leaves is the main attraction. I introduced this plant from England and had it in my garden for about four years. Then one summer, it mugged off. Meanwhile, I've gotten it fairly well distributed among "mom and pop" nurseries over here. One nursery listing it is Glasshouse Works in Ohio (10 Church St., Box 97, Stewart, OH 45778-0097).

In a lovely Connecticut garden owned by Mary Ley, dwarf bearded iris has been very attractively planted as a drift around a large boulder. Mary's garden is not overly large, but this is an excellent example of the placement of a small plant that otherwise could look rather lost in a big garden.

In a garden in Richmond, Virginia, a small border, with emphasis on foliage plants, has been planted against a north wall. A north-facing wall is a good place for a border in hot climates. In the South it's much more pleasant to tend a border in the shade than to work in July and August in the kind of hot sun that makes you think of the Sahara Desert. Plants in this shade border include bergenias, astilbes and coral bells (*Heuchera*). A north-wall border I know of in Scotland features a planting idea that can be translated very easily into any of our gardens: box-hedge edging with hosta massed behind the boxwood. In this case, the hosta selected was *Hosta undulata* 'Albomarginata,' but there are many hostas with similar white-edged leaves. A golden ivy *(Hedera helix* 'Buttercup') grows on the wall behind the hostas. A nice idea for borders is to grow daffodils under hostas, which come up very late in spring, just in time to hide the dying foliage of the daffodils. Usually, I advise against mixing daffodils with perennials, but they can be combined very successfully with hostas or with robust kinds of daylily.

In an Ohio garden that features a large collection of beautifully grown plants, there is a sizable pond that has been allowed to leak a bit in order to create an area for moisture-loving plants. Included among these are large quantities of hostas, particularly *H.* 'Royal Standard,' which flowers fairly late in the year and is slightly fragrant.

Dry shade under trees, a condition many of us are familiar with, is a difficult situation in which to garden. But some candidates that will survive it are ferns, many of the epimediums and the hardy begonia, *Begonia grandis*, formerly *B. evansiana*. This begonia's beautiful red veining is displayed best when it is planted so that the light shines through its leaves from behind.

In my garden I have what I consider to be one of the loveliest of all ferns, the Japanese painted fern. I've combined it with a hosta I really took to my heart this year, *H.* 'Louisa'—of modest size, with lovely spikes of pure-white flowers. An exquisite plant, the Chinese lace fern, *Selaginella involvens*, combines beautifully with other ferns. If you don't have this one, I suggest that the moment you get home, you write to Woodlanders, Inc. (1128 Colleton Ave., Aiken, SC 29801) and order it. It's usually evergreen for me, but probably wouldn't be further north, although it is hardy.

Epimediums are of two kinds: running and clump forming. One of the fairly rapidly spreading ones, *Epimedium versicolor* 'Sulphureum,' is dry-shade tolerant, although it would prefer more moisture. It needs protection from full sun. *E. grandiflorum* 'Rose Queen' is of the clump variety, increasing slowly. And a smaller clump former is *E.* x *youngianum* 'Niveum.' *E.* x *warleyense* is a running kind with tangerine-color flowers. It's important to cut off the remaining old leaves and dead stalks from epimediums in winter or very early spring. The new growth is fragile and easily damaged if the tidying up is too late. And the plants will look very unkempt if you don't trim them back at all.

I have become increasingly aware of the need for some kind of cohesive fac-

tor to unify all the elements of a perennial garden. In one particular garden in Ohio, this was accomplished with a gray-foliage edging to the border—like a ribbon binding a bunch of flowers. The plant used in this case is sold as *Orostachys iwarenge*, though it's probably a different species. It is a succulent and very hardy for this category of plants. The Ohio garden is mostly shady, but daylilies are grown successfully in its sunniest parts. The prettiest daylilies, I think, are those with flower sizes that are in proportion to the overall dimensions of the plant. We're seeing too many tiny flowers on tall stems, or grossly big flowers on quite short plants. A well-proportioned one in the Ohio garden is 'Little Grapette'—with flowers of grape-jelly color.

The owner of this garden, Mr. Meyer, told me he's always seeing lists of plants that cannot be grown under walnut trees, and he wishes someone would come up with a list of things that *can* be grown there. He compiled his own, then planted a trial bed around a walnut tree in his garden. He had no trouble creating an attractive grouping made up of a variety of thriving plants. Among these are Japanese painted fern and a beautiful dark-leaved coleus, which is kept over winter by cuttings grown indoors. The color of the coleus picks up the maroon veining in the Japanese painted fern. In another section of the bed, is the beautiful *Hakonechloa macra* 'Aureola,' sold under various other names, but always the same plant—a lovely grass for a shaded and not-too-dry situation. From a distance the overall color effect of this plant is yellow, but up close, some pink is evident in its leaves. I liked the way the delicate arching blades of the grass picked up the coloring of the very big leaves of *Hosta* 'Frances Williams' in the background.

Houttuynia cordata *'Variegata,' a beautiful foliage plant, can be invasive; place it carefully.*

H. 'Frances Williams,' number one in the Hosta Society polls, is a showy plant if you can keep the slugs off it. Slugs are a problem with hostas, and the bigger the leaf, the worse it looks, with all those holes chewed into it. I asked Mr. Meyer about this because his seemed to be in very good condition, free of slug damage. He said he tried slug pellets, but they were not effective. The slugs stayed right on the leaves; they didn't bother to go down to feed on the pellets. He finally eradicated the pests with a liquid-chemical slug killer, sprayed directly onto the leaves.

Plants with variegated leaves have impact throughout the growing season; they're usually effective for longer than the flowers. One that's not very easy to grow, but well worth trying is *Brunnera macrophylla* 'Variegata.' The creamy edges of its leaves tend to scorch in heat or drought. But if you give it moderately moist soil, a little shade and watch out for slugs, you should have success with it. The variegated comfrey, *Symphytum uplandicum* 'Variegatum,' is easier to grow. As an alternative to patterned foliage, a cobbled area provides interesting textural variety in the garden. It is also a good way of dealing with a space that's often difficult to plant, such as under a large tree. Hostas and astilbes provide nice foliage contrast when used sparingly amid the cobblestones.

When I find a particularly striking garden, I can normally be certain of two things: A, the owner is an artist of some kind or has had some art training, or B, there has been a great deal of inspiration from nature. One of the buckwheats, *Eriogonum umbellatum*, I think, grows wild amid the rugged gray granite of the California Sierras. In the garden of a friend, Harland Hand, in El Cenito, nature's mountain scenery was recreated

***Epimedium* x *youngianum* 'Niveum'** *tolerates dry shade. This cultivar is the most compact in habit.*

with common basket-of-gold, *Aurinia saxatilis*. Concrete was used to mimic the Sierras' granite. *Aurinia* is another of those plants that tend to rot if their roots get too wet. But in Harland's garden, they're tucked under the concrete. In his granite-bound garden in Larchmont, New York, Harold Epstein planted Solomon's seal in the rock crannies, but you would think that the plant put itself there. It couldn't have because it's Japanese Solomon's seal. But it looks as if it did, and that to my mind, is successful gardening—when you don't know whether a gardener's or nature's hand was responsible. A similarly natural effect was achieved with *Dicentra eximia* in the Massachusetts cliff garden belonging to Margo Parrot.

A note or two about color in the garden: orange is perhaps the most difficult to use successfully. In a Richmond garden, 'May Queen' was planted with shasta daisies. 'May Queen' is a cultivar of the oxeye daisy, *Chrysanthemum leucanthemum*, with the same propensity for seeding itself everywhere. That was no problem, however, in this southern garden because the beds were edged with boxwood. More orange was provided by poppies, which are annuals, and blue was added in the form of *Salvia superba*. On a background wall *Lonicera* 'Dropmore Scarlet' picked up the orange theme. This plant is perfectly hardy up north and flowers for most of the summer.

The theme of my talk is "the grace notes of the garden." One plant that can become the "disgrace" note of the garden is variegated goutweed, or ground ivy (*Aegopodium podagraria* 'Variegata'). One of the first of the big battles in my English garden involved getting rid of this invader. But then again there's the question of situating plants properly. Goutweed found its rightful place in the garden of the Tryon Palace in North Carolina. It was used there in mass and successfully held in check by some paving—a very effective planting. If this frequently troublesome plant strays onto the driveway, weed killer can be used. If it appears in the lawn, the mower will take care of it.

Some very interesting developments occur whenever one starts a conversation on the subject of color; every individual thinks differently about it. In spite of evidence to the contrary, I personally find that orange and pink clash. It's a tremendous help to have had training in flower arranging because if colors combine well in an arrangement, they will look right together in the border.

There's great interest now in white gardens and in blue gardens—single-color or two-color gardens. At Sissinghurst yellow and orange flowers are combined, and I think this is the best way of using orange—grouping it with red and yellow, keeping it away from the pinks and purples. Another English garden, Peter Healing's in the Cotswolds, has a lovely red and purple border, which I think is far better than the much more famous red and purple planting at Hidcote. If you're going to have color themes of this kind, you have to draw on the whole range of garden plants; perennials are not enough. You'll need shrubs and annuals. The purple barberry, *Berberis thunbergii* 'Atropurpurea,' and purple sumac, *Cotinus coggygria* cultivars, are basics in a red and purple border. There's a white

Athyrium goeringianum 'Pictum' and Hosta 'Louisa.' *Hostas and ferns combine well in texture and color, and are excellent plants for a shaded garden.*

Hosta sieboldiana *'Frances Williams' was voted number one in a Hosta Society poll. Hostas are excellent plants for shady areas where bold foliage adds color and interest. Flowers are fleeting at best.*

garden at Ladew Topiary Gardens—again drawing on bulbs, shrubs, the whole range of plants. Many of the lovely white edged, or variegated, hostas are appropriate for the all-white garden, especially if it's in shade.

I've been familiar with the red and purple pairing for a long time, but yellow and purple combined in the garden was new to me. The herb garden at Hever Castle in England contains yellow and purple predominantly. I thought it a very attractive theme, one that could easily be carried out in quite small gardens for a long season of foliage interest. Let's consider some yellow and purple foliage plants: the sage, *Salvia officinalis* 'Purpurascens' and golden oregano, *Origanum vulgare* 'Aureum' make a good duo. Actually there are a host of plants with golden foliage, another being the golden sage, *Salvia officinalis* 'Icterina.' If you'd prefer a single-color garden, that's probably a good route to take. In my own garden, I find golden oregano an excellent edging plant. It spreads fairly rapidly, but densely. Other possibilities for a golden garden are variegated lemon balm *(Melissa officinalis* 'Aurea'), golden variegated hosta, golden thyme (*Thymus vulgaris* 'Aureum') and a host of golden conifers and deciduous shrubs.

There aren't too many purple foliaged perennials. A particularly nice one is purple leaved fennel. It's not very long lived, but usually provides seedlings once it has established itself. Purple leaved canna is another. There are now quite a few golden leaved hostas, such as 'August Moon' and 'Kabitan.' The variegated lemon balm is a bit invasive and must be kept in check. It needs a moist soil. There are purple leaves on the little violet known incorrectly, but at least universally, as *Viola labradorica*. This plant seeds itself very nicely. I don't think it's a nuisance, but once you have it, you'll probably see quite a bit of it here and there in the garden.

Taking one last look at golden-foliage plants, consider the various variegated liriopes, although these are more suitable to the South. Black mondo grass, *Ophiopogon planiscapus* 'Nigrescens,' is hardier than many of the liriopes. Creeping Charlie *(Lysimachia nummularia* 'Aurea'), golden alyssum, golden barberry and golden privet hedges make a nice combination.

In a small herb garden at Hollington Herbs in England, *Iris pseudacorus* 'Variegatus' grows in a tiny pool. What was intriguing about this was the way in which a fountain splashes onto the area where the irises were planted, thereby providing permanently moist soil. I thought this was a very attractive and original idea for plants requiring this condition.

I would like to offer a tribute to those from whom I have learned so much about perennials. I expect most of you know the famous island beds of Alan Bloom at Bressingham. He is responsible for so many good plants and for much of the world's interest in perennials. If you want the definitive work on perennials, I would say that it's still Graham Thomas' book on the subject. Even though it was written for England, it's tremendously helpful in the United States. His retirement garden is a combination of his favorite plants—shrubs, perennials, bulbs, vines, something of everything. He has a remarkable talent for putting a finger on just that one distinctive aspect of a plant that enables you to identify it without its picture.

Every year in my garden there is one plant that I get more excited about than any other, and this year's plant is Japanese blood grass, *Imperata cylindrica* 'Rubra.' It's an absolutely stunning plant and increasing faster in my garden than in Fred McGourty's. This means it likes a light, sandy, acid soil, and it can take all the sunshine you care to give it. So if your soil is wet and heavy, give this plant the best drainage you can and full sun. It spreads nicely but not invasively—a lovely, lovely plant.

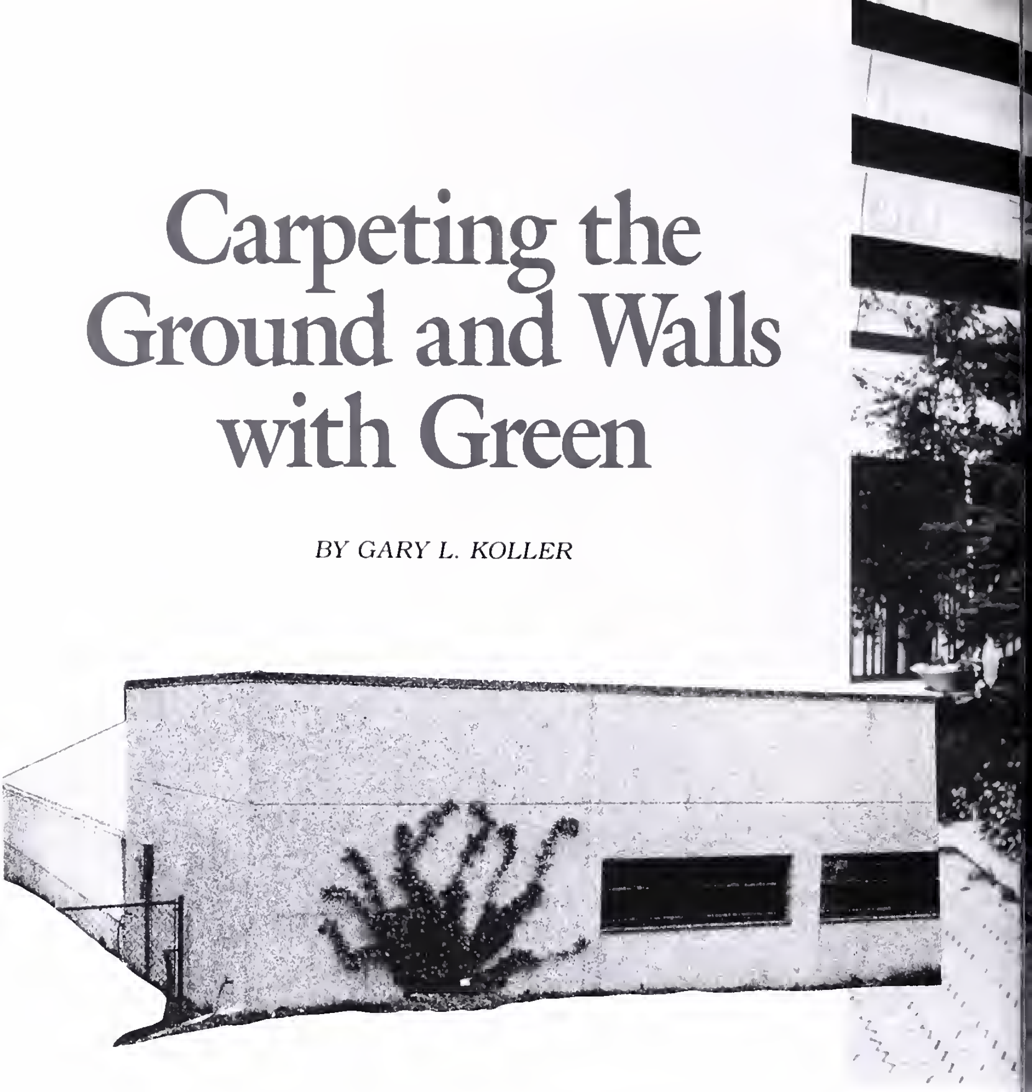
***Geranium sanguineum lancastrense**, left, is among the best hardy geraniums for gardens all over the U.S. Flowers are soft pink with crimson veining. This geranium is easy to care for.*

***Viola labradorica.** There aren't too many purple foliaged perennials, but this is one. Once established, it seeds itself nicely, and you'll find it popping up everywhere in the garden.*

***Salvia officinalis 'Purpurascens'** and* Origanum vulgare *'Aureum' make a good border combination.*

Carpeting the Ground and Walls with Green

BY GARY L. KOLLER



Photos by Gary Koller

I'm certainly delighted and pleased to be here for the Seventy-Fifth Anniversary Symposium of the Brooklyn Botanic Garden. As a child, I always looked to the BBG as a source of leadership, of inspiration, of setting standards in horticulture. This tradition continues and I'm certainly pleased to be a part of the anniversary celebration honoring seventy-five years of excellence in American horticulture.

I would like to discuss some of my ideas on the use of vines and ground covers as green carpets in the landscape. In our modern urban settings, we have many spaces that lend themselves to carpeting with greenery. These include walls, shrub borders and areas that would normally go to weeds. The urban environment presents a number of trying situations: air pollution, wind drafts and wind tunnels, people pressures and animal pressures, among others. Not knowing how to overcome these adversities so as to grace, soften, beautify and improve the aesthetics and quality of our urban landscapes, we often abandon troublesome

areas, not planting anything at all.

Frequently in our urban settings we are faced with the intrusion of industrial complexes, and in areas that could have been planted to some types of living ground cover, we layer asphalt, extending lifeless pavement and hard edges. Not very attractive, do you think?

Our modern outdoor spaces are shrinking, becoming smaller and smaller as real estate prices escalate. So in some urban areas, ground covers and vines become good choices. Ground covers can be used in small and awkward spaces and vines can creep up and across the faces of buildings to soften city masonry. Awkward areas are difficult to maintain, to mow, to walk on. Many have been planted to shrubs. Others have such architectural features as retaining walls, which add to the problem.

A common ground cover, pachysandra, is a good choice to overcome one frequently encountered challenge, a steep bank. This versatile specimen can also serve to define planting beds, as well as walkways and circulation patterns through the garden. Used to frame a pathway, pachysandra helps define its edges and encourages visitors not to wander

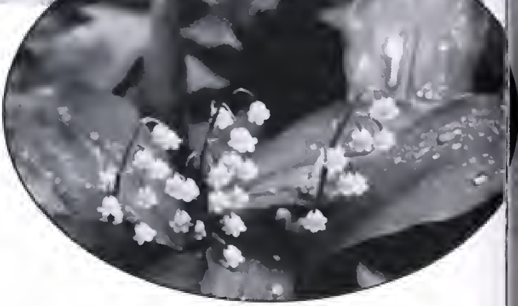
Hydrangea anomala petiolaris, *climbing hydrangea, above, left, will cling without aid. Here it grows attractively on a building at Missouri Botanical Garden.*

Hosta species, *above, center, used as a ground cover under evergreens. Asphalt and pavement cover vast areas in urban situations, creating a harsh environment. Pockets of green relieve the somber gray.*

Santolina chamaecyparissus, *above, right, lavender cotton, growing at Kew Gardens. Handsome, whitish gray leaves clothe woody stems. Yellow flowers appear in summer, providing plants are not clipped.*

Gary L. Koller, Managing Horticulturist at Harvard's Arnold Arboretum, is co-guest editor of *P&G's Ground Covers and Vines.*

***Hosta species**, above, surrounded by edging of* Liriope spicata *(creeping lily turf) form a highly pleasing contrast.*



***Convallaria majalis** 'Rosea,' lily-of-the-valley, provides a persistent green cover long after flowers are gone.*

beyond them. Keep in mind, however, that a ground cover capable of growing to knee height or higher should be selected if you wish to prevent visitors from being tempted to walk through it.

Another application of the use of pachysandra is as a unifying element in an island planting, adding cohesiveness to a variety of plants. In combination with *Juniperus procumbens nana* (Japanese juniper), yucca and a dwarf Alberta spruce, for example, this particular ground cover can be an attractive unifier.

A small strip, such as that between a driveway and the wall of a building is often either planted with grass or abandoned entirely, allowing weeds to take over. But why not use pachysandra to create a little garland at the base of the building? It doesn't do a great deal, yet it ameliorates the harshness of the transition from the driveway to the building wall.

Have you ever thought of mixing pachysandra with other ground covers—lily-of-the-valley, for example, or with a combination of European ginger and Solomon's seal? Interplant pachysandra and/or many of the other ground covers with early spring bulbs, so that when the bulbs are spent, a persistent and constant carpet of green will remain.

Now let's proceed to a few other ground covers and tell you why I think they might adapt to your landscape. First is a plant with yellow-green flowers—lady's mantle, *Alchemilla mollis*. It is used in perennial gardens as an individual plant, and you'll see it occasionally here and there in borders and in rock gardens. But it's not often thought of as a wide-area ground cover. It's drought resistant, quite persistent and is fairly shade tolerant. The flowers are not spectacular, but the plant is kind of charming in both its texture and the appearance it creates in a garden setting. The chartreuse blooms remain in good condition for perhaps four-to-six weeks in my garden, at which point they turn brownish and you can cut back the flower stalks, if you wish. The leaves of the lady's mantle are quite attractive because they're pleated, allowing them to catch little beads of dew or rain water that shimmer in the sunlight.

European ginger, *Asarum europaeum*, is a very elegant ground cover. It is particularly good for city locations with shade and adequate moisture through the summer. It is evergreen, providing both summer and winter aspects. *Asarum canadensis*, the Canadian ginger, is a cousin but not evergreen. When frost comes, it dies back to the ground, but tolerates dry conditions and shade. It also combines nicely with pachysandra, creating a tapestry effect of dark and light greens. Canadian ginger looks attractive all summer. I find it rather aggressive, and my only negative comment about it would be that in August, during the height of the summer drought, it will wilt, but if watered immediately, will pick up.

A Japanese woodland plant which I think deserves more use and recognition is *Kirengeshoma palmata*. This is a plant which gets to be about two to two-and-a-half feet tall in my garden. I like it for its foliage because it is bold and distinctly architectural, allowing great textural and foliage-color opportunities in the summer garden. I have found this plant to be quite shade and drought tolerant. Contrary to what you may have read, it seems to be more drought tolerant than most people give it credit for. It looks good all summer. Summer for us in Boston has been a little humid and wet lately, so there's a small amount of slug damage on my plants. Flowers appear in late September or October. I find these a bit disappointing because they're pale golden yellow and not presented very effectively. So I respect the plant for its foliage and late-season interest. I understand that there are new selections of *K. palmata* which have better flowering character, but I have yet to see them.

A question we get frequently at the Arnold Arboretum is, "What can I grow in dense, dry shade?" One of the most successful plants I've found is yellow archangel, *Lamiastrum galeobdolon*,

Plants of ***Alchemilla mollis****, lady's mantle, are mostly grown individually. But multiple plantings can create a ground cover of unusually interesting texture and character.*

variety *variegatum*. It's a plant which in mild climates is pretty much evergreen. Up in the Boston area it's evergreen until perhaps Christmastime, and then the harsh cold gets to it, forcing it to die back to the ground. It comes up very early in April and begins flowering in May. The foliage has silver markings and is especially effective in shaded locations because the little dots of silver pick up the light and offset the gloom of deep shade. I've seen this cover growing under Norway maple trees and beech trees where it's often very difficult to establish other herbaceous plants. Its flowers (golden yellow) appear in early May in the Boston area. There's a new cultivar put out by Wayside Gardens with silver speckling through the leaves. I think it's 'Herman's Pride,' and is not quite as vigorous as the typical form.

One of my favorite ground covers is a plant called *Lamium*, spotted nettle. *Lamium maculatum* has been in the trade for many years. It is available in rose-pink and white flowered forms. The one I would like to share with you is called 'Chequers.' 'Chequers' is much more drought and shade tolerant than most of the other *L. maculatum* cultivars. In fact, in my garden it is aggressive. It invades by seeding itself into areas where it really doesn't belong. It begins with a heavy flowering flush in May, and then blooms sporadically all summer long. I've had 'Chequers' in bloom in my garden until Thanksgiving time which is quite late for this plant in the Boston area.

A new evergreen that I saw earlier today here at Brooklyn Botanic Garden has interesting texture and color. It is *Microbiota decussata*, Siberian Juniper. It is closely related to juniper but treated as a separate genus. *Microbiota* is a new evergreen in the nursery trade. It looks like a juniper, acts like a juniper, but provides a slightly different color and texture in the summer landscape. Plants at the Arboretum have gotten to be about ten-to-twelve inches tall and have spread to a carpet four or five feet across. It seems to be a little more shade tolerant than some of the cultivars of juniper. Its only negative aspect is presented in the wintertime when it grows in full sun. It turns a brownish-purple color which I think is dreadful looking. When you grow it in shade, it retains its greenness.

One of our native plants that certainly has proven to be very hardy and drought tolerant is Allegheny pachysandra, *Pachysandra procumbens*, which is not nearly so common as the Japanese pachysandra, *P. terminalis*. This native species is deciduous, as it dies back to the ground in autumn. It is very slow to spread, and this is one reason it hasn't achieved the popularity of the Japanese pachysandra. It has nice foliage throughout the summer, is highly drought tolerant and fairly shade tolerant. Appearing in April before the leaves, *P. procumbens*'s flowers are not spectacular, but they're certainly noticeable.

Paxistima canbyi, rat stripper, is a small broad-leaf evergreen native to the mountains of the South. In winter or as the temperatures get cooler, the foliage is bronzy purple. In the spring it turns green, and in the early part of that season, small white flowers appear. This evergreen grows well in full sun to moderate shade.

Some of you probably grow epimediums, bishop hats, which are very successful ground cover plants, or specimen plants for the shaded garden. *Vancouveria*, a relative of the epimediums, comes from the Pacific Northwest. *Vancouveria* has very light, lime-green foliage throughout the summer. It sends up a crop of delicate, creamy-white flowers in early June. The foliage texture and pattern of *Vancouveria* is much more subtle than many of the epimediums. However, it's not quite as drought tolerant as most of its epimedium relatives.

A woody ground cover that deserves greater use is yellow-root; its scientific name is *Xanthorhiza*. This is a shrub which I regard as highly adaptable. It will grow in full sun and adjust readily to shade conditions. And it tolerates fairly dry soil as well as lower, wetter, more marginal soils. Its autumn foliage color appears after all other trees have lost their leaves. *Vinca minor* will colonize successfully under yellow-root and will provide a contrasting green aspect throughout the winter.

I'd like to switch my focus now from carpeting the ground to carpeting walls. Among our great neglected spaces in cities, I think, are their vertical expanses—the naked masonry walls that predominate everywhere. Vines can be used very successfully to define and enhance these spaces. For example, I have Boston ivy growing on my house. This vine clings on its own, and one of the pleasures I get from it is that each year I sculpt it into a new pattern. I go through both lean and lush years, but every year provides a different look to my house because of the configuration of its climbing Boston ivy.

The use of vines in the landscape affords a variety of architectural opportunities. We can build trellises, gazebos, arbors, all kinds of structures on which

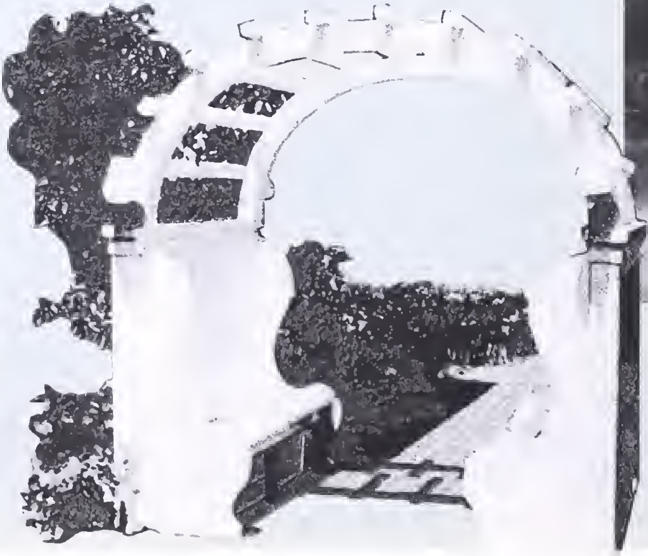
Veronica spicata *'Icicle,' left, is grown more for its matte-green foliage than its flowers.*

Tiarella cordifolia, *foam flower, below, an excellent white-flowering ground cover for partial shade.*

Cerastium tomentosum, *above, snow-in-summer, a low-growing perennial with gray foliage.*

Sedum *'Autumn Joy'* *in bloom and* Festuca ovina glauca *(right, foreground) combine nicely.*

Vines covering entryway trellis provide a leafy bower and shade.

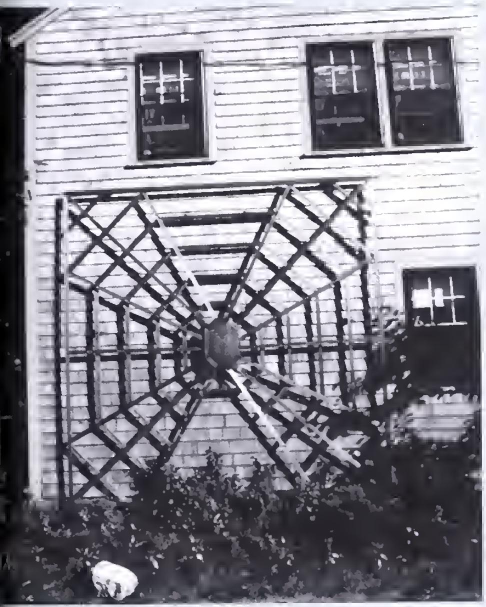


A vine (Vitis species) grown to treelike form. This example is at Kew.

Trellis over benches, when covered with vines, will create a shady, restful spot.

Wisteria *arbor, left, is in Reading Garden of the Garden Center of Greater Cleveland.*

Another *wisteria arbor. This one, of metal, is in N.Y.'s Central Park.*



A trellis *at the side of a house suggests a giant spider was at work.*

to hold, support and display vining plants. And these don't necessarily need to rise from the ground. A trellis structure over an entryway, for example, creates a leafy bower and provides welcome shade. Trellises can also be used to create outdoor "rooms" that provide screening, enclosure and privacy.

Fences are another means of support to consider for vining plants. How many of you have an ugly chain-link fence in your neighborhood? There are too many in our urban landscapes, and we have come to accept them too readily. One way to turn this blight into something beautiful is to cover it with a vine tapestry. Along a chain-link fence at the Arboretum, I've planted autumn clematis, *Clematis paniculata*, interwoven with Dutchman's pipe, *Aristolochia durior*. In the summertime these vines weave themselves throughout the webbing of the fence, creating a handsome wall of both coarse and fine leaf textures.

How many of you would consider snuggling a vine-covered trellis against a fence? I never really considered it until I saw an example of the arrangement and thought it very attractive.

An old windmill in Pennsylvania that was once used to pump water now has a great wisteria vine growing on it. I've seen an unused telephone pole down in Newport, Rhode Island, that at some point had a wisteria vine planted at its base. Slowly the vine has covered the pole and now you can't see it anymore. We struggle to grow trees in our modern landscapes, sometimes very successfully, but often unsuccessfully. In many cases we would do better to consider a concrete column, a tall pole or other abandoned structure and grow a vine on it.

Landscape architect Bill Frederick has trained a wisteria at the Arnold Arboretum onto pipe structures with branch-like arms, creating in effect small "trees." In our home landscapes and cityscapes, couldn't we provide clever supports like these for vining plants such as roses? An automobile parked in the sun at the height of summer can get as hot as an oven. But the leafy canopy of a vine trained to a simple galvanized-pipe-and-wire structure can shield your car from the mid-day sun.

I would like to talk now about a number of vines that creep, crawl or climb in a variety of ways. Trumpet vine, *Campsis radicans*, is a native plant. If you go into the Midwest or parts of the South, you'll find this vine growing along hedgerows and climbing up into trees. It blooms in mid-summer, with flowers that can be orange, reddish or a kind of canary yellow, depending on the cultivar. Trumpet vine is a very vigorous and aggressive grower, and is in the category of vines that cling unassisted. Just provide it with a tree or trellis and it will cling fast and climb entirely on its own.

Another vine that clings without aid is climbing hydrangea, *Hydrangea anomala petiolaris*. This one is rather beautiful for the mid-summer flowering period. It blooms in early June for us in Boston, has creamy white bracts which are quite showy, and has the distinction of being able to flower freely in light to moderate shade. It doesn't need full sun to do well ornamentally, as many of our other vines do. When it grows up a tree, it puts out little root-like hold-fasts which actually grab onto the bark and support the upward ascent of the vine. It can climb to 75 feet or more. Native to China and Japan, this plant is one of the very best of all the woody, clinging vines.

I've not seen this vine behave like bittersweet or some of the other vines which twist around a tree in such a way that they actually choke or strangle the tree as it increases its girth. This twisting effect is eventually harmful to the tree. It's my opinion that a vine really won't hurt a tree otherwise, unless it starts covering and obscuring the upper-branch canopy so that the tree can't get an adequate supply of light.

Another vine which is very common in our landscape is Boston ivy. It clings and has attractive color—light green to dark green depending on its exposure to light—throughout the summer. In autumn, it turns a handsome burgundy. Once you have it established, it will be dependable for many, many years and will probably out-live you. This is the vine that covers the halls of Harvard University. Recently workers have been removing the climber from many of the Harvard buildings because it presents a maintenance problem. Fifty thousand dollars a year was being spent to prune it, and it was decided that this was prohibitive. So a stripping process began, which I think is a shame. But I can appreciate the decision from a cost-effectiveness standpoint. Where I do think Boston ivy could be used effectively is on a big, windowless, brick wall. This is the appropriate place for this plant—where it can grow freely to cover a huge expanse without the need for fre-

quent maintenance. Boston ivy is an interesting plant to intermix with English ivy because the English variety will present green color all winter. Combine this with the burgundy of the Boston to create a lovely tapestry during the fall and winter months.

Porcelain berry, *Ampelopsis*, is a wonderful plant related to grapes. *Ampelopsis brevipedunculata* 'Elegance' has white markings on its leaves and is a vigorous grower once it is established. It is very successful on a lattice structure and its only disadvantage is that Japanese beetles are fond of it.

Another plant that will grow as a climbing, twisting vine is Dutchman's pipe, a native to North America. You see it often in old landscapes in Maine and New Hampshire, but it is not much used in modern gardens, unfortunately. It has very large, heart-shaped leaves and bold character, providing great opportunity for design. One of the interplays I like is Dutchman's pipe with Chinese silvergrass, *Miscanthus sinensis gracillimus*, in front of it. You get the narrow leaf blade of the Chinese silvergrass against the large, heart-shaped leaves of the Dutchman's pipe.

Also capable of creating a wonderful tapestry companion on a chain-link fence with Dutchman's pipe is sweet autumn clematis. This vine, cut to the ground every year, comes back up in one season's growth. Sweet autumn clematis is what I call a "well behaved" vine. There are both well behaved and dastardly vines, and among the dastardly varieties are wisteria, bittersweet and actinidia. These twist and turn, and when they've consumed their support, they reach out and try to grab you! Have you ever walked down a path at night and been snatched about the ear by a vine? The nice thing about the well behaved varieties—Dutchman's pipe, sweet autumn clematis and silver lace vine—is they tend to contour themselves rather tightly to their supports and don't reach out.

Hydranga anomala petiolaris*, native to China and Japan, clings without aid. It can climb to 75 feet or more, and its flowers, with showy, creamy bracts, make a beautiful display during the month of June.*

Most of you probably have seen and tasted kiwis, *Actinidia chinensis*, which are delicious fruit native to China. A hardy species of *Actinidia*, *arguta*, is an interesting vine. It is cold-hardy to minus 35 to minus 40 degrees F. and very vigorous-growing, much like a grape. It twists and twines, creating a large, full-bodied plant, given time. Like the Chinese kiwi, its fruit has green flesh, little black seeds and, unlike its Chinese cousin, smooth skin. It is eaten much as one would eat a grape, without peeling it, so it is very convenient to bring to the table or serve at a buffet.

Actinidia is becoming more and more common; increasing numbers of people are expressing interest in it. One of the research projects at the Arnold Arboretum is on micro-propagation and tissue culture. An interesting discovery to come out of this work is that a very important chemical for rooting and for the development of growth—cytokinin—is present in Actinidia. One of the Arboretum researchers is on the verge of developing a means of synthesizing cytokinin from this particular plant. When this is accomplished, it will be the first time cytokinin has ever been isolated. Its movement through the plant and its means of activating various chemical systems will be examined.

Another relative, *Actinidia kolomikta*, the kolomikta vine, also produces a fruit. As well as this welcome distinction, kolomikta has white and pink markings on its leaves, making it an effective addition to the shade garden. However, the prevalence of these markings is highly variable; our specimen at the Arboretum has handsomely distinct markings some seasons, while during others, these are almost completely absent. A variety of cultivars is available. I don't believe we have one of the best at the Arnold, but the

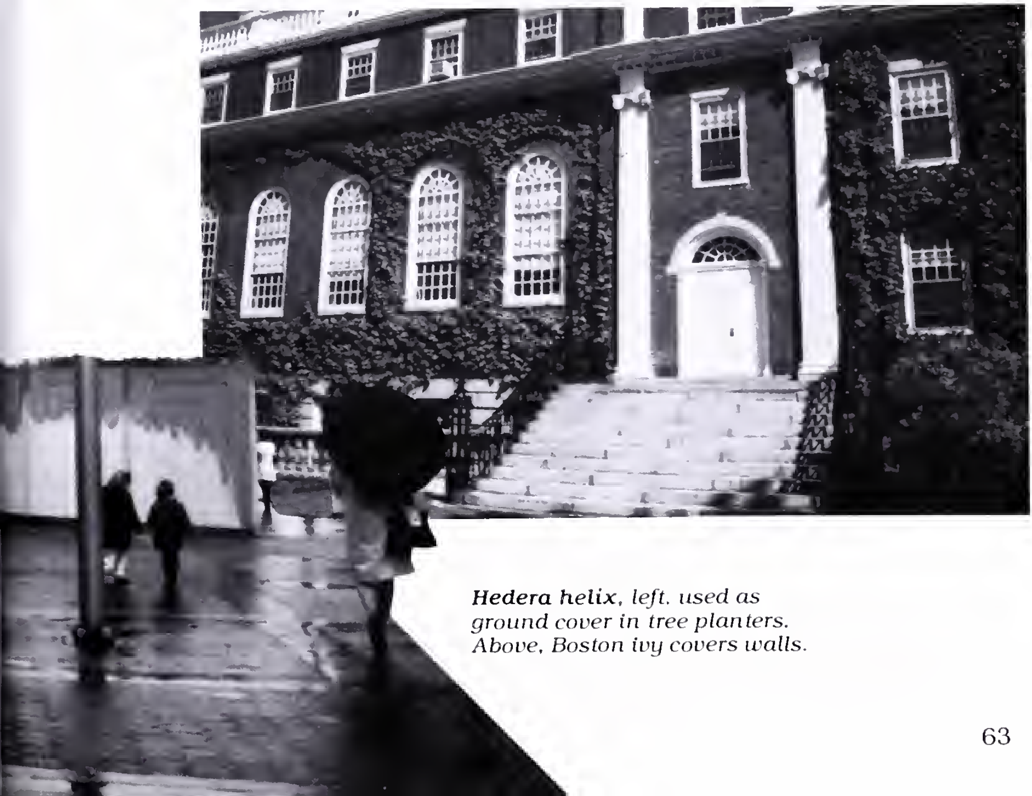
National Arboretum has new selections which are really superior. Many can be found in the present issue of the Wayside Gardens' catalog (Hodges, SC 29695).

Another edible-fruit vine appropriate for the urban landscape is *Vitis*, grape. This is an excellent arbor grower, ideal for sheltering a terrace or sitting area. Annual forms could be better utilized in the urban landscape, especially in community gardens or in areas where a touch of summer color is desired.

Morning glory vines thrive on drought, poor soil and otherwise difficult circumstances. Ironically, if you pamper them with ideal conditions and care, they won't grow or flower as well. Developed, I believe, by Japanese breeders, new cultivars come in blue, white or pink blooms which stay open throughout the day and into the evening.

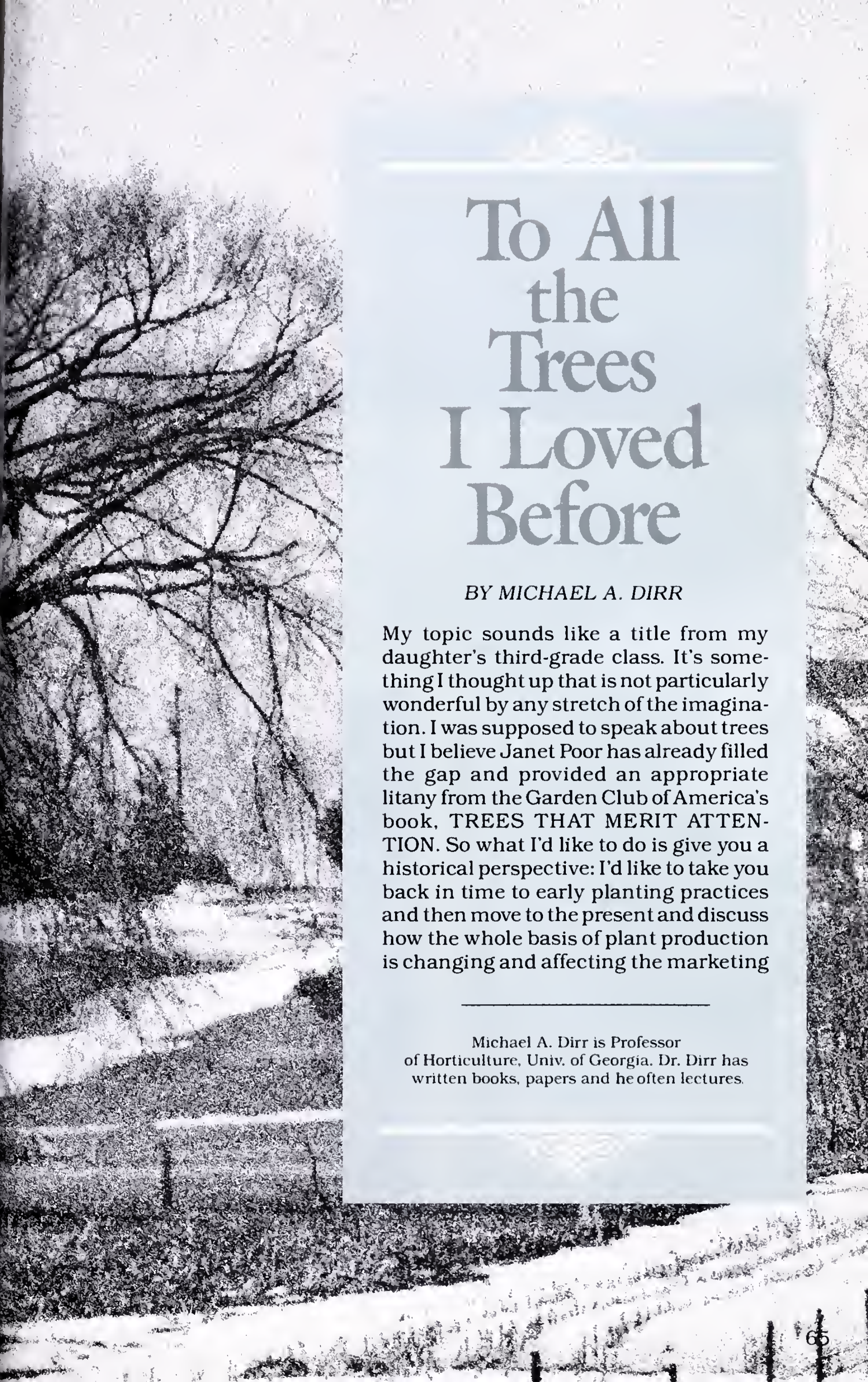
In behalf of the Arnold Arboretum's continuing tradition of plant collection and introduction, I'd like to present an unusual specimen to Betty Scholtz in honor of the Seventy-fifth Anniversary of the Brooklyn Botanic. This is not a very impressive looking plant but it represents a new genus to North America—*Heptico-dium jasminoides*, a member of the Honeysuckle Family. I was in China in April and saw only one specimen of this plant in all the botanic gardens I visited. We've been cranking them out like jelly beans at the Arnold Arboretum and now probably have more examples than exist in all of China. I present this specimen to you on behalf of the Arboretum staff. We'll come back in twenty-five years, when you celebrate your hundredth, to see how it has fared. I'm not going to tell you what it does because I want all of you to come back and discover for yourselves the kind of grower it is and whether or not it has performed well as an ornamental here at the Garden.

***Parthenocissus tricuspidata**, left, covers chapel walls at Boston's Mt. Auburn Cemetery. Commonly known as Boston ivy, this vine clings to surfaces readily. Its attractive, dark-green leaves turn to burgundy in autumn. Once established, Boston ivy is dependable for many years. It is the ivy that Harvard is presently removing from its buildings because of maintenance difficulties.*



***Hedera helix**, left, used as ground cover in tree planters. Above, Boston ivy covers walls.*

A great and treasured tree, the American elm



To All the Trees I Loved Before

BY MICHAEL A. DIRR

My topic sounds like a title from my daughter's third-grade class. It's something I thought up that is not particularly wonderful by any stretch of the imagination. I was supposed to speak about trees but I believe Janet Poor has already filled the gap and provided an appropriate litany from the Garden Club of America's book, TREES THAT MERIT ATTENTION. So what I'd like to do is give you a historical perspective: I'd like to take you back in time to early planting practices and then move to the present and discuss how the whole basis of plant production is changing and affecting the marketing

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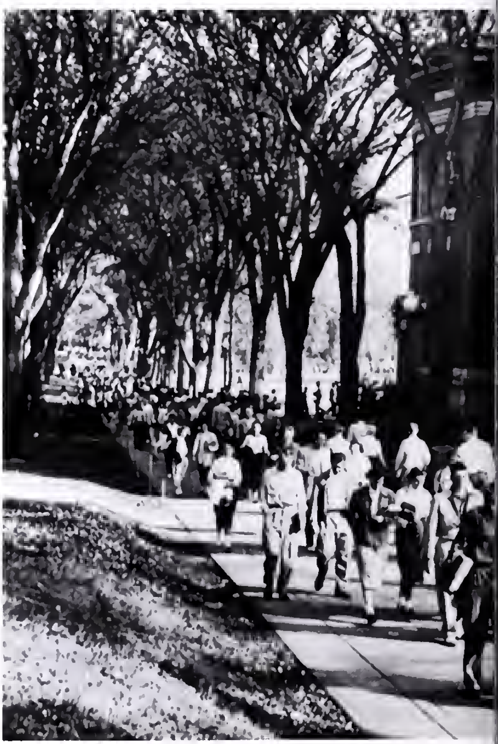
of trees. It is amazing what has happened. Most trees at one time were seed grown, with some produced through grafting and budding. Now production has shifted to cuttings and tissue culture. Plants are also being produced through protoplast regeneration, and the future offers the possibility of genetically engineered material. Finally, I want to present an overview of several favorite trees.

A great tree, and one that is obviously treasured in American cities, towns, municipalities and countrysides, is the American elm. In a sense it is a dinosaur in many areas of the United States. We certainly spend a great deal of money to protect it. I was in Central Park in New York last November and looked at Geraldine Weinstein's work. A fantastic job of preserving the elm is being done at the park, but the expense and time involved—I don't know if it's justified. Horticulturists and foresters should do a better job on the front end—breeding and producing new trees. I look at what happened to the American elm as just one sequence in evolution, hastened a degree by man's activities. But man is, of course, a part of evolution. We have been able to fill the gap with other trees, but certainly nothing as grand as the American elm.

If you were to walk with me on the green in Falmouth, Massachusetts, you'd see wonderful examples of this tree, but just a small remnant in numbers of what used

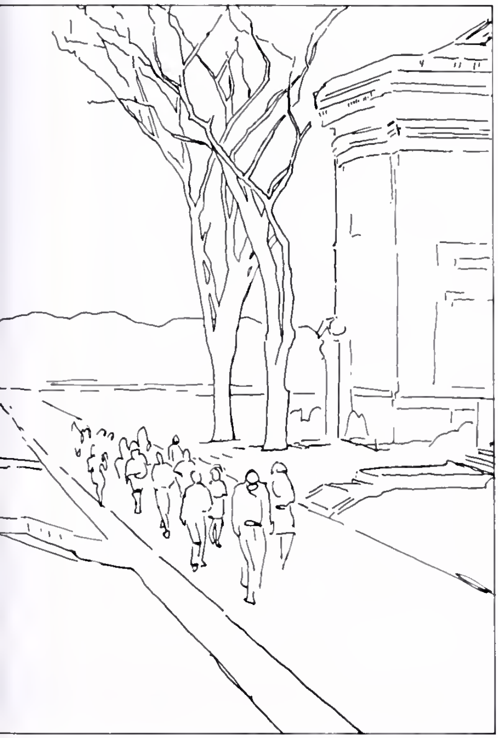
On the Falmouth, *Massachusetts, green, wonderful examples of stately American elms are just remnants of what there used to be.*

American elms, *below, left, at the University of Illinois, Champaign/Urbana, formed a beautiful cathedral archway in 1950. But with the spread of Dutch elm disease, only two were left by 1960, below, right.*



to dominate Cape Cod. The campus of Penn State University is adorned with the American elm. In fact, I'm sure the tree is ingrained in the memory of every student who has walked on any campus in eastern North America. And that runs all the way from the northern border of the U.S. to Athens, Georgia. In Washington, D.C., attempts have been made to replace the American elm, but again, they may be futile; the characteristic cathedral-ceiling effect cannot be achieved with any other tree, including zelkova.

I'd like to describe for you the evolution of an American elm planting at the University of Illinois at Champaign/Urbana. The first building on the campus devoted to the study of Agriculture, Davenport Hall, was on a treeless prairie in 1900. By 1935 it was surrounded by American elms. This particular species was planted to the exclusion of virtually all others. The broadwalk at the University was lined with American elms and as they matured, the beautiful cathedral archway was formed. By 1950 all of the elms were still in place. But Dutch elm disease was spreading violently throughout the country and in the space of ten years, a dramatic change took place. By 1960 only two American elms were left along the University's broadwalk. So much for monoculture!



After the demise of the elms, the campus was replanted with honey locust, that wonderful, ubiquitous *Gleditsia triacanthos* var. *inermis*. In fact, the place was overwhelmed with honey locust because the landscape architect involved liked the tree and thought the use of a single element fostered unity and cohesion throughout the campus. By 1980, the honey locusts had formed a canopy over the campus walks and streets. This was only twenty years after the initial plantings. Unfortunately, problems with the trees began to surface. Web worm, root rot, nectria canker, locust plant bug and mites became commonplace. All of the trees planted along the broadwalk and on the quadrangle have since been removed. The monoculture syndrome prevailed again and the price was paid in full. Diversified planting schemes are now the campus rule, the silver linden, red oak, sugar hackberry and Japanese zelkova the most frequent replacements. The point is that it took two monoculture disasters for the powers that be to learn the lesson of diversification.

I've enjoyed walking along the Blue Ridge Parkway, taking in and admiring remnants of the American chestnut. If you hike anywhere in the southern Appalachians, you will see chestnut snags, seemingly dead remains from which new growth sprouts. Chestnut wood is extremely rot resistant, and this is another classic example of a tree that was almost eliminated by a disease (*Endothia parasitica*). What I wish to say by these examples is that man is somehow or other able to re-engineer and cover the scars. Nature participates in the healing process, and if chestnut snags and root sprouts had not evolved, most of mankind would be deprived of the chestnut's existence.

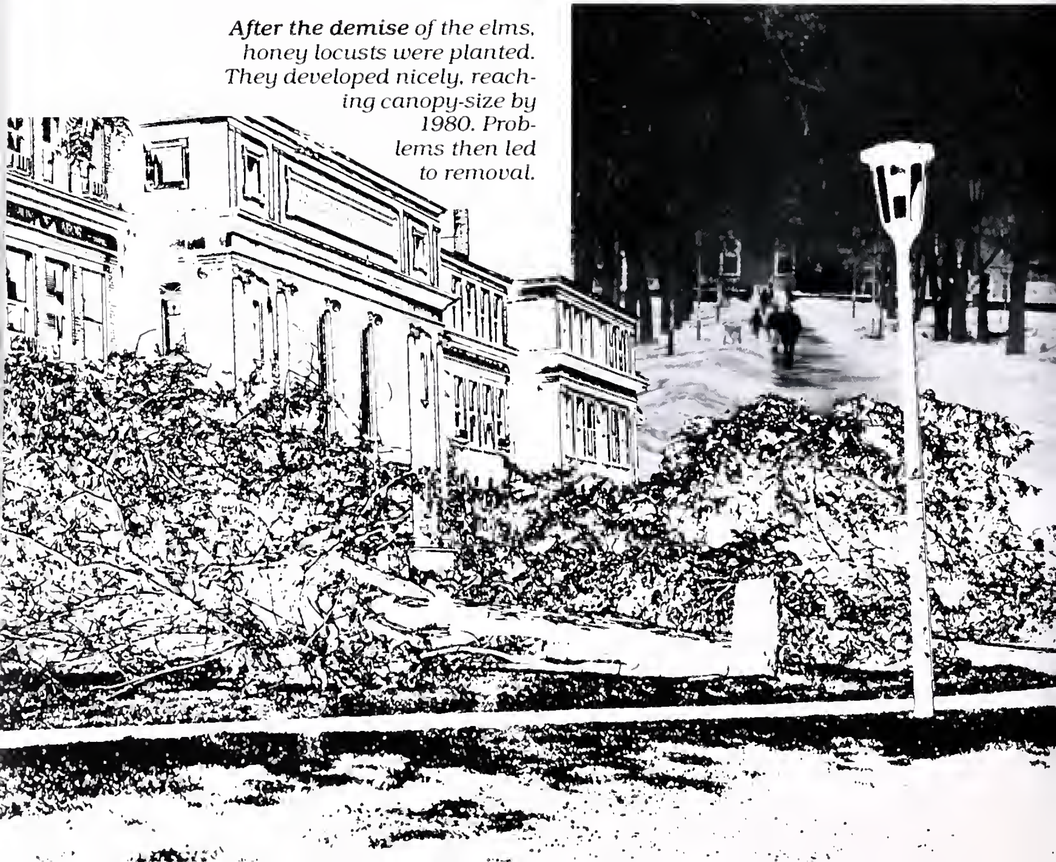
I like to think of the environment as a spider web. It's a very fragile meshwork and if one link is broken, gaps occur and the entire matrix is weakened. However, it seems that we've been able with time to repair the gaps, and it's my opinion that we're now in a re-greening mode in North America.

I would like to talk briefly about production techniques. Before the afternoon session started, Gary Koller and I were discussing tree sources. Who actually introduces new trees? Does Brooklyn Botanic Garden? Does Mike Dirr through his writings? No, it is largely the nurserymen of North America, and throughout the world, for that matter, to whom the introduction of trees can be traced. These growers seldom worry about disease resistance, or urban, drought, salt and other tolerances. Rather, they're looking for varieties that caliper fast, form nice heads, have outstanding fall color, transplant readily and propagate without difficulty. I don't know if you've really thought about it, but tolerances are seldom considered. Precious few nurserymen have introduced trees that are well adapted to harsh conditions.

Production techniques have changed over the years. Today seedlings are commonly used as understocks, to bud various cultivars. You may ask why. The answer is rather obvious. For instance, there are twenty-five to thirty cultivars of red maple in existence and more will appear. Some of these, as well as other tree cultivars, are patented, many are trademarked, and the introducers are collecting royalties of approximately fifty cents per tree. It makes good business sense to select cultivars with quality ornamental characteristics: the trees are uniform, command a premium price and please the customer. Seedling production allows a nurseryman to sell approximately fifty percent of his material.

Production practices for certain trees

After the demise of the elms, honey locusts were planted. They developed nicely, reaching canopy-size by 1980. Problems then led to removal.

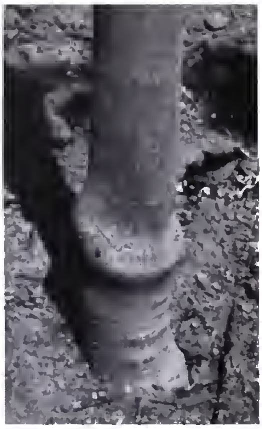


have changed from seed to budding to own-root or cutting. One of the problems that initiated the change in modern shade tree growing was graft incompatibility. This was not noted initially. But when customers bought budded red maples, for example, incompatibilities developed over a period of years, forcing the nursery industry to find alternative production techniques. The cultivars are now rooted and grown as "own-root" plants. In fact, I know one southern nurseryman who grows 'Red Sunset' and 'October Glory' and refuses to buy anything that's budded or grafted. He used to lose four percent of his budded trees per year, and over four years, while bringing those trees to marketable size, he lost sixteen percent or more of the crop. That sixteen percent was the profit margin. Consequently, production techniques had to change.

One of the symptoms of bud or graft incompatibility is the development of a "horse-collar" or "horse-hoof" type swelling at the bud union. If you were to apply gentle pressure to the trunk at that point, a clean break occurs. The graft simply never heals, and trunk splitting can take place spontaneously at any point in a tree's life—in its earliest years or, as studies indicate, as late as its thirtieth. Nurserymen knew that they had to solve the problem or go out of business. So they collaborated with university researchers, and the rest is history.

Another aspect of tree production to consider is the growing system. Most trees are field grown but there is an emerging trend toward "bag" and container culture. The Lerio Company is now producing trees grown in containers as large as ninety-five gallons. Nurserymen are growing three to three-and-a-half inch diameter shade trees in containers, and doing almost as good a job as field producers.

How is this accomplished? Water flow is regulated through drip irrigation. Plant materials are monitored constantly for the presence of diseases and insects. Fertilizer is either injected through the watering system or applied in slow-release form. The advantage of the timed-release fertilizers is that, theoretically, they need be applied only once during the growing season. No matter how long or short the season of a particular plant might be, an appropriate formulation is available. So tree production has arrived at the level of widget production; nurserymen can do a reasonably good job of literally turning out "carbon copies."


***One symptom** of bud or graft incompatibility is the development of a "horse collar" swelling at the union. Slightest pressure can break the union.*

Tissue culture is a technique that holds great promise for tree propagation. If a nurseryman or breeder develops a new selection that he wishes to make available as quickly as possible, his best choice would be to multiply it by means of tissue culture. There are over a hundred commercial contract tissue culture laboratories in the United States that he could choose from to do the procedure. He would have to pay an initial fee and agree to buy back a specified number of the plants eventually produced. One large English company, Twyford, has established a California laboratory that has the capacity to produce twenty-five million plants a year. Think of what it could do for mountain laurel. Traditionally it has been very difficult to propagate this plant from cuttings, and seedlings tend to be highly variable. Jaynes, with his admirable breeding program in Connecticut, produced all these wonderful cultivars, but no really successful way to propagate them. And tissue culture made *Kalmia* available to the gardeners of the world. No longer is it the sacrosanct plant it once was. Woody plants, particularly such trees as birch, pear, magnolia, maple, plum and crabapple are now commercially available through tissue culture. And many West Coast concerns specializing in growing specimens to salable size are starting with tissue cultured plants. Again, the ultimate goal, as always, is to produce a quality, marketable product.

Katsura tree, *Cercidiphyllum japonicum*, supposedly cannot be grown in the South. But on the Georgia campus, we have absolutely magnificent specimens that are approximately forty feet tall and thirty to forty years old. So much for the pronouncements of the "experts." Katsura offers lovely blue-green summer foliage followed by yellow to apricot fall color. The habit is variable, from upright pyramidal to wide-spreading. The bark is ruggedly handsome and offers winter interest. Katsura requires ample moisture in the early years of establishment. Thereafter it is trouble-free. There are several weeping forms. Among them are *C. japonicum* 'Pendula' and *C. magnificum*. 'Pendula' is the small version. It looks like blue-green water flowing over rocks. I don't see this form getting any bigger than fifteen or so feet. People say it's too slow growing, like the weeping beech. But one small plant I first noticed in 1977 in Spring Grove in Cincinnati grew to ten feet, with wide, graceful branching, in just four years.

Another plant that's simply magnificent is *Nyssa sylvatica*, the black tupelo or black gum or pepperidge tree. It has a very wide north-south distribution that takes it from Maine to Florida and Texas, and it grows in wet soils. I've seen it growing on hillsides in Indiana, by fresh-water ponds on Cape Cod, and in mixed forests in Georgia. It is tremendously variable in its growth habit and fall color, and superior selections could be made. This is one of the best native trees for autumn color, ranging from yellow to orange-red to deep purple. Its branching pattern, especially among young trees, is a hub-and-spoke arrangement. Its bark has a blocky nature, almost like that of dogwood or persimmon, and is extremely handsome, with lots of winter interest.

Parrotia persica *has beautiful bark, with its jigsaw-puzzle conformation in shades of gray, green and brown.*

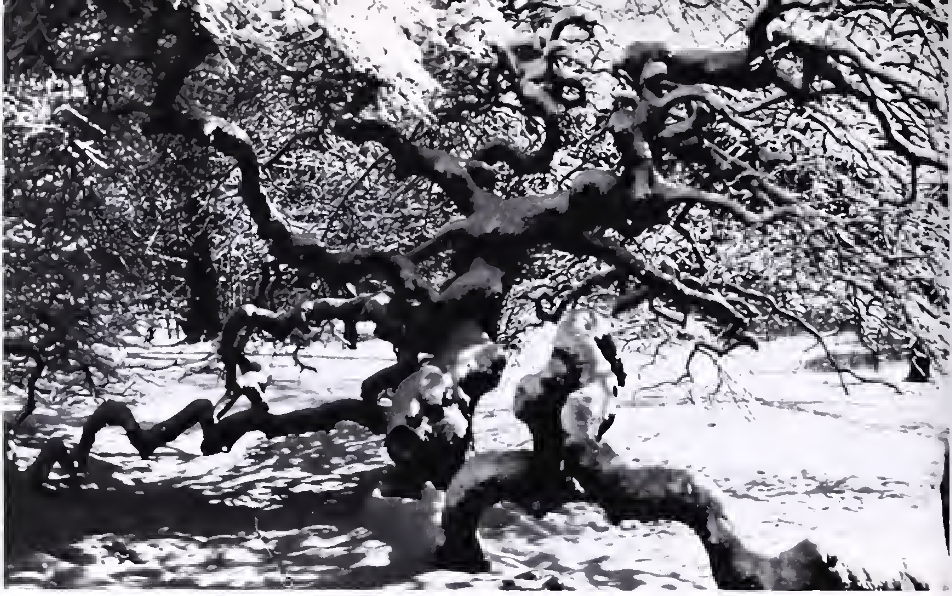
***Nyssa sylvatica*, left,** *black tupelo, is a magnificent tree. It has variable growth habit.*

***Oxydendrum arboreum*,** *left, sorrel or sourwood tree. Above, detail of flower. Fall color, in shades of red to scarlet, is magnificent.*

lesia
rolina, *left.*
oms in early
ril in Georgia.
ıas white, bell-
ape flowers.

Cercidiphyllum japonicum *'Pendula' is blue-green in color.*

***Aesculus* x *carnea* 'Briotii,'** *the ruby-red horse chestnut, is a beautiful tree.*



***Fagus sylvatica* 'Tortuosa'** *has twisted, convoluted branches—striking even in winter.*

I'm sure you've seen *Vaccinium angustifolium*, a little gem known as lowbush blueberry, or at least photographs of it. In Maine, this tree makes the countryside look as if it were on fire. In the South, we achieve the same effect, almost, with *Oxydendrum arboreum*, the sorrel tree, sourwood or lily-of-the-valley tree. In June–July when it is in magnificent flower, there is nothing like a grouping of this particular tree. It's simply beautiful. And the green of its foliage is perfect—neither too dark nor too anemic. Fall color is gorgeous, ranging from subdued red to almost scarlet. Growth is precocious, with flowering and fruiting occuring at a very early stage. The fruiting capsules, which hang from the branches all winter, provide an interesting and unmistakable identification feature and are ideal for use in dried arrangements. BBG has a wonderful example of this tree on the hillside directly behind this building.

I like to look at plants closely, and I make sure my students understand that plants have seasonal characteristics that endear them to gardeners. I teach multi-season identification, and urge my students to examine characteristics closely and form their own opinions about them.

There is a tremendous specimen on BBG grounds of *Parrotia persica*. Just absolutely gorgeous—first time I've ever seen it. But the flower—when does flowering occur? February and March. The rich green summer foliage turns multihues of yellow, orange, red and purple in fall. Even the bark is beautiful, with its jigsaw puzzle conformation in shades of gray, green and brown. A weeping form is *P. persica* 'Pendula'. Every time I go to Kew Gardens—I've only seen this form at Kew—I pay it homage. I've climbed under the plant and found that its big central trunk has the same exfoliating bark as the species. Can you imagine this cascading into little red flowers—the crimson stamens in the spring? I just think it's an outstanding plant for the garden. Obviously it's not going to grow too fast.

The literature classifies parrotia as difficult to root. But it isn't the rooting that's difficult, it's the overwintering, or protecting it from the cold, once the plant is rooted. One of the large commercial tissue culture labs is presently culturing two witch hazels, and my feeling is if witch hazels are amenable to this means of propagation, then parrotia will be, and can be made more readily available.

My home property is in Watkinsville, Georgia, a "large metropolis" of twenty-five people, in a very beautiful part of the country. It's a great place to live, raise children and bask in the glories of nature. Life there is a bit different than it is in the kind of "concrete jungle" that surrounds Brooklyn Botanic Garden. *Halesia carolina*, Carolina silverbell, can be found throughout the wilds of the north-Georgia mountains—always along stream banks, usually above flood level and in reasonably moist soil. I have a lot of it on my property where white, bell-shaped flowers peak in early spring—early April for us in Watkinsville. These blooms are gorgeous, as handsome as those of any flowering plant. This is not a biennial, like many crabapples.

Halesia's pink form, *H. monticola* 'Rosea', comes in at least two shades, one very soft pink and one a little deeper. By the way, halesia roots easily from cuttings and is a "piece of cake" as far as tissue culture is concerned. I just came back from our American Society for Horticultural Science meetings where a fellow from Ohio State reported successfully establishing the plant through tissue culture. Silverbell's bark is beautiful, and its fruit—a four-winged dry drupe that is difficult to germinate—is magnificent.

I think European beech, *Fagus sylvatica*, is perhaps the grande dame, if you will, of all trees—noble to a fault, almost. Its winter silhouette can be magnificent and the variation in cultivars is absolutely fantastic. One thing really fascinating about European beech is the tremendous variability it has exhibited over the years, while our American beech has produced no named cultivars. The European form is exceedingly utilitarian. If any of you have been to Edinburgh Botanic Garden and seen the twenty-five-foot hedge that serves as the backdrop for its perennial border, you can appreciate this tree's purposefulness. 'Asplenifolia', the fern leaf beech, is a form of *F. sylvatica* that is more delicate than the species. It's very lovely. *F.* 'Laciniata' is not as deeply cut as 'Asplenifolia'. Many of these cultivar differences amount to splitting hairs. Fall color for 'Asplenifolia' is a rich, golden brown. The purple beech, 'Atropunicea', goes through a color transformation as the season progresses—from very light copper to almost a black purple. Then, depending on the cultivar in question, the purple beech turns a green or greenish purple color. If you don't like purple beeches that grow upright, there are kinds available that have a hanging growth habit. One weeping form is called 'Purple Fountain'. And if you don't like purple, there is a yellow weeper, 'Aurea Pendula'. The yellow foliage fades, by the way, on this to conventional green during the growing season. 'Zlatia' is a yellow-foliage form with an upright growth habit. One could create a wonderful garden with nothing but beech cultivars. Many of you know 'Roseo-marginata' but there's another called 'Tricolor' which has three distinct bands of white, rose or pink and purple. One of my greatest disappointments in moving to the South was the inability to grow these beeches. The American beech is native down into Florida, but we cannot grow the European variety because of the heat.

'Rohani' is a purplish, oak-leafed form of European beech that fades to green. A *F. sylvatica* in Gary Koller's collection in Boston, 'Rotundifolia', is a small, round-leaf form—a very lovely tree, with a more compact habit than the species. One of the finest beeches, 'Fastigiata', planted in a row, is reminiscent of a line of soldiers marching across the landscape, and is a great choice for screening purposes.

I visited a nursery in northern Alabama, and a fellow there said, "I don't understand why my English oaks aren't upright. I saw them in Atlanta and they were just like telephone poles." Obviously he had seen *Quercus robur* 'Fastigiata' but had "fastigiate oaks" in the nursery. These were ten times wider than high. I said, "You don't have the right tree." He said, "What do you mean I don't have the right tree?" I said, "Don't you understand? There are all kinds of cultivars . . . ," and I went into this long explanation. Sometimes it's difficult to make someone understand how a species like European beech or English oak can produce a variety of shapes and colors. How about the weeping beech ('Pendula')? Even among clones, I've not seen two that are exactly alike. Each one is different. The Hunnewell Estate in Wellesley, Massachusetts, has one of the finest specimens in the country. In summer it is simply spectacular and, unlike many plants, remains an elegant beauty even in the dead of winter. Then there's the famous contorted beech, 'Tortuosa'. Wow! What I wouldn't give to have that in my backyard. There happens to be one in the Arnold Arboretum's backyard, and its twisted, convoluted branches are cause for reverence and reflection.

A good specimen of *Aesculus x carnea* 'Briotii', the ruby-red horse chestnut, is as beautiful as any tree. It's a considerably better choice than the common horse chestnut, with greater resistance to leaf blotch and mildew. A cross between our native, southeastern *Aesculus pavia*, red buckeye, and the common horse chestnut, it grows all over the world. In the United States, I've seen it in Salt Lake City, Boston, San Francisco and Cincinnati. I'm convinced there are varying forms of 'Briotii'. Some are almost pink, while others are a true red.

A choice tree that no garden should be without is *Davidia involucrata* var. *vilmoriniana*, the dove tree. It tends to be temperamental,but there is nothing more ethereal than a well-grown, mature specimen. I am reminded of the beautiful examples at Swarthmore and at Arnold, and there are some in LaGrange, Georgia, that are performing magnificently. The dove tree's foliage is rather innocuous, but still handsome—strongly toothed, with deeply pleated veins. Its white bracts, possibly seven inches long, wave and flutter in the softest breeze. This is not a tree to be appreciated from a distance, but the kind you should sit under and view up through its canopy. It's not a street tree, but a garden variety of the first order, one that E.H. Wilson would call an aristocrat.

The last tree I'd like to talk about, one I've chased around the globe, is *Acer griseum*, the paperbark maple. This one does not grow well in the South; the heat slows it down. However, I have two that are grafted onto sugar maple. It's a difficult tree to propagate, but I'm sure tissue culture would solve the problem. Only eight to perhaps ten percent of its seeds are ever sound, and they're doubly dormant, meaning that if you had sown the seeds this fall (1985), seedlings wouldn't appear until the spring of '87, and sporadically thereafter. Most nurserymen want a quick turnover, however, and for this reason, don't find this tree desirable. But Gary Koller and I, among others, have been strong proponents of the trifoliate maples. In addition to *A. griseum*, these include *A. triflorum*, *A. nikoense* and *A. mandshuricum*. These have probably been touched upon at one time or other during this conference.

What makes the paperbark maple really special is its adaptability to soils that are calcareous, as well as acidic. Great numbers grow on the Illinois campus, where rhododendrons and azaleas developed chlorosis and languished. For seven years, I watched the Illinois maples and never witnessed good fall color—only muted shades of red and brown, for some reason. In Boston at the Arnold Arboretum, however, fall color was a spectacular red. Why choose this particular tree? For its magnificent exfoliating bark and great character. It can be planted to good advantage in groupings of three to seven.

The great gardeners and designers of the world have been able to take the elements—some of the plants I have discussed today—and combine them into what I call landscape paintings. I consider Hidcote and Sissinghurst among the finest examples. All of the trees mentioned today and yesterday certainly merit attention. They are true aristocrats, and I urge you to make nurserymen and botanic garden personnel aware of your interest in these superior plants. Many nurserymen are vitally concerned about the question of new plants, but, at the same time, must return a profit. Propagation, production, willing sellers and willing buyers insure that new plants will be available. I trust that this presentation has increased your awareness of the ongoing changes in tree selection and production techniques.

Exfoliating bark of Acer griseum *is lovely and provides interest.*

A. ***griseum*** *is dramatic in the winter landscape. It is a tree with great character.*

Poor planting *situations and man's inattention to problems often spell doom for plants.*

MAINTENANCE: Facing the Hard Facts of Life

BY MARK ZELONIS

It truly is an honor to be included in a program featuring such distinguished people in the field of horticulture. As for myself, I'm a horticulturist by training and by education; but by no means do I consider myself a "plant expert." And although I've designed and executed gardens of various types, I am by no stretch of the imagination a "garden designer" or landscape architect. You may then be asking, "What the devil is this guy here for?" Well, I do love plants and use them for creating enjoyment and beauty for others. My primary concern, however is CARING for gardens once they've been designed and the plants planted. Nothing hurts me more than to see a plant or a garden poorly cared for. What I have to say is directed primarily at plants in the public realm (i.e., botanic gardens, arboreta, parks, zoos, city streets, etc.). However, the thoughts will certainly hold true for private gardens as well.

I'm sure many of us have awakened from a deep sleep and gone to the bathroom sink to splash cold water into our bleary eyes to wash away the foggy dreams and cobwebs of sleep. We walk away a little wet behind the ears, but refreshed and awake. After hearing about so many wonderful plants from our symposium speakers yesterday, we all need a good splash of something to wake us up and bring us back to reality. Stories about all these great plants can lull us into a state of semi-consciousness and euphoria where we stumble blindly ahead, arms outreached, begging for yet another handsome plant for our burgeoning gardens.

As the title of my talk indicates, I was invited here this morning to be that awakening splash, that sobering thought in a session of otherwise encouraging talks by our panel. I am here today to ask the question: "Are we as gardeners and horticulturists properly designing, and in the case of public horticulture, budgeting for our gardens' necessary upkeep and long-range survival?" "Or are we, as have so many in the past, simply ignoring the inevitable, and allowing time, neglect, and poor planning to ravage the gardens we paid and sweated so much to create?" What I wish to stress is the absolutely vital importance of maintenance for our plants and gardens. I also wish to show you how through proper planning, new techniques, and improved

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plant selection, today's gardens may be enjoyed for generations to come.

First of all, what do I mean when I talk of maintaining a garden or a group of plants? Well, my dictionary definition of TO MAINTAIN is: to keep in a condition of good repair, efficiency, or use. At first this seems straightforward. But like so many things in life, it's a bit more complicated than just that. What is good repair to one person may not actually be the proper course of action. We've all seen spreading yews or junipers sheared into flat-sided hedges, or columnar arborvitae trimmed into round gumballs. We've also all seen trees and shrubs suffering in the middle of a hot and dry city traffic island.

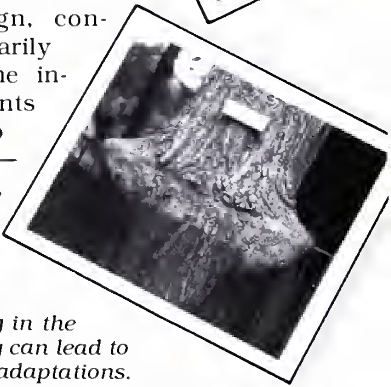
What I'm trying to get across is that we quite often improperly design gardens and landscapes utilizing the wrong plant material for the site, or improperly maintain plants that are actually better suited for another purpose. I hope you will all see that good repair, efficiency, and use are all interrelated. It is extremely wasteful to neglect the maintenance of expensive plants, or use those same expensive plants in a poor design. Wouldn't it make sense to spend some time following up the money and time invested in our plants?

Why many people and institutions continue to repeat previous mistakes, I really don't know. All of us complain about the prices of everything being so high. . . so why do we waste so much? The city of Providence, Rhode Island, just finished planting nearly 100 seven to eight-inch caliper London Plane trees in the revitalization of its downtown Kennedy Plaza. I'd conservatively estimate the cost of each tree at $500 to $800. Yet months after the trees were delivered to the site, the trees sat unplanted, drying out and near death. There was absolutely no guidance provided for their planting and eventual maintenance. As a matter of fact, after the city spent $7 million on the park project, not one cent had been allocated for the site's care!!!

I don't know the exact figures for planting a new tree in a city sidewalk or park, but it surely must be more expensive to replace that tree than to provide it with basic scheduled care, including watering, occasional feeding, and judicious pruning. I dare say everyone in this room fully realizes the value plants have in our lives—from the psychological benefits of cool green foliage and cheery blossoms, to the more financially beneficial aspects of a tree-lined setting for our homes and communities. So why do so many of our gardens, parks, and other plantings fail?

To me the key lies in the statement by Glenn Black in the premier issue of *Grounds Maintenance* magazine some 20 years ago: "The future of any landscape project lies almost wholly in the hands of the person who will be maintaining it." Two words of that statement stand out—FUTURE and MAINTAIN. Most anyone, including me, can design a garden to look good when first planted —healthy plants set in a bed of fresh shredded bark mulch and surrounded by a backdrop of deep green turf. It's a sight to make anyone step back and admire.

But I know from my own limited experience that it is easy to get caught up in the actual design, concerned primarily with how the individual plants will relate to each other—their shape, texture, and color. But what



***Poor planning** in the very beginning can lead to strange plant adaptations. Above upper, a hedge has grown around an urn, while, lower, a large tree has been forced into bizarre growth by fence.*

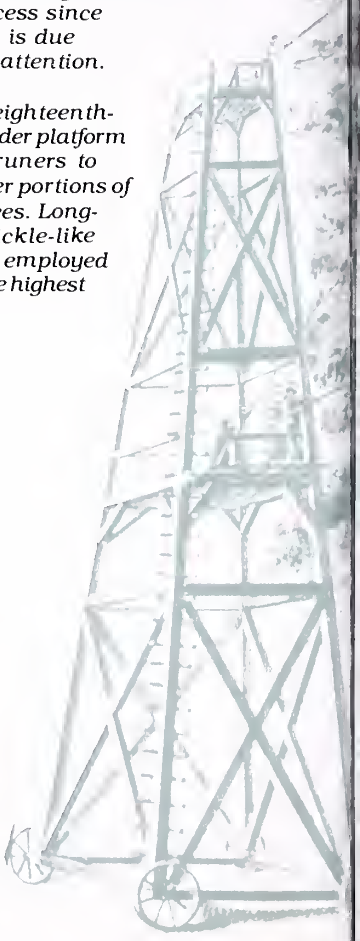
about showing a little concern for how these plants will fare in the long run? Have they been planted too close? Is the equipment necessary to maintain them even available? Does anyone know how to use it? Can the person or institution for whom the garden was designed even afford to maintain the planting properly? Have the maintainers of these plants and gardens been coached as to what the designer had in mind?

I urge all designers to talk with clients, and if they're not the ones to do the actual maintaining, then please talk to that person as well. Explain what it is we've created, that much time and money was invested to create it, and that we would very much like to have it turn out the way we envisioned it.

Landscape designers involved only with the initial planting (and leaving all the maintenance and replacement details to others) are selling their profession short. They have an obligation to see that their plan is carried out properly. Most of us are familiar with the gardens of designer Beatrix Farrand. Two of her best (and incidentally two of my very favorite gardens anywhere) namely Dumbarton Oaks in Washington, D.C., and the Abby Aldrich Rockefeller Gardens in Seal Harbor, Maine, together involved over 50 years of Mrs. Farrand's professional life. Her success and the obvious success of these two masterpieces is due in large part to the ongoing attention she gave them long after their initial creation. At Dumbarton Oaks, for instance, she laid out her intentions in her *Plant Book* so that even after her death, everyone would know what she had in mind.

As in tennis and golf, it is the "follow-through" in landscape construction that makes the difference. Many of the intricate and elaborate estate gardens of the turn of the century no longer exist because of a lack of proper follow-through. Owners of these country-seats and "summer cottages" as they were often called, were anxious for an instant effect in their landscapes. They often

Dumbarton Oaks, *Washington, D.C., above, is one of Beatrix Farrand's finest garden designs. Its continued success since its creation is due to ongoing attention.*



Right, *an eighteenth-century ladder platform enabled pruners to reach upper portions of very tall trees. Long-handled, sickle-like tools were employed to reach the highest branches.*

***Above, General Sherman Park** is an excellent example of careful design. Elements include irrigation system and plant selection for long-term interest. **Brookside Gardens,** Wheaton, Maryland, left, devised an effective design for a bank. Mowing is eliminated and heavy mulching prevents weeds and reduces watering.*

would instruct their designers such as Jacques Greber, Ernest Bowditch, and Samuel Parsons to plant lushly so as to create an immediately mature effect. It is all too often done the same way today.

The designers of the day frequently planted several fast-growing species surrounding what would eventually be the specimen plant. They knew what should be done over the years, that certain plants be periodically removed or at least pruned back. But I'm afraid the word was often not passed on—neither to the estate's caretaker nor the estate's future owners. The result: a mass of overgrown and out of place trees and shrubs that disfigured each other and endangered nearby buildings. It is very sad to realize how few gardens of that earlier time still exist in anything approaching their original form.

But getting back to 1985, how many landscape architects and designers do you think, when designing for a large institution, public garden, estate, or campus, call in the grounds superintendent to ask his opinion? Not many I'll bet. Yet they're often the first to complain when the finished product doesn't look quite the way they had in mind. Philip Hatfield, himself a landscape architect, said in a recent issue of *Grounds Maintenance:* "If the landscape designer is not able to convey to the maintenance personnel what he intends to accomplish through the design in terms of artistic configuration, color, form, and texture, the landscape will never reach its full potential and his design as originally conceived, probably will fail."

A good grounds manager is versed in so many aspects of horticulture, including personnel administration, fiscal management, construction, engineering, safety, environmental issues, and the like, that he would have a very good idea of what it would take to maintain a proposed new planting in terms of needed manpower, equipment, and time. He is in the best position of anyone to determine if a certain proposal is even feasible. He could also help sell to his boss the virtues of certain labor-saving amenities such as mulch, edging, or automatic irrigation. His boss, of course, just so happens to be the designer's boss as well.

And in knowing how much it would take to maintain a proposed new design, the grounds manager can even advise on plant material that would require less upkeep. I've read of a fascinating research project at Caltech in Pasadena that shows the many hundreds of plants on campus rated by the amount of time required to properly maintain them. Not surprisingly, roses were rated as the most time-consuming. You can imagine how useful this information would be when the inevitable budget cuts come, and the grounds department is forced to look at where to cut back and what to eliminate.

Much of what I've been alluding to involves knowing just what exactly one has to maintain. The old adage of "You can't manage what you don't know" keeps coming to mind. More and more parks systems and municipalities are developing management systems and manuals to deal with the complexities of the situation. The city of Montreal, for example, has on computer a complete inventory of its street trees, over 300,000 of them! They know at the push of a button or two the species and/or cultivar, its size, condition, and any other particulars about it. A schedule is produced by the computer to alert the maintenance crews as to what work is needed and on what trees. The same is being done right here in New York City with the thousands of trees in Central Park.

In Newark, Delaware, City Horticulturist Rick Colbert keeps track of exactly how many hours are spent maintaining his many award-winning traffic islands located throughout the city. In a matter of moments Rick can tell you which islands are the most time-consuming or which are nearly maintenance-free.

This came in handy recently when the city asked Rick and his crew to design, install, and care for some new plantings alongside the Interstate-95 exit into the town. This was to be done, of course, without adding to his budget. When Rick explained, with facts in hand, that two or three existing traffic islands in town (ones with corporate sponsors, I might

The rose garden at Fuller Gardens, North Hampton, New Hampshire, requires intensive care. However, perfection can be achieved through constant attention.

add) would need to be dropped to make up for the new plantings, the city council quickly dropped the idea.

With facts like these, people responsible for maintaining our gardens and landscapes can make more logical decisions regarding planning, scheduling, budgeting, plant selection, and design. In some cases, for example, it may prove practical to farm out some maintenance jobs to outside contractors. We do this at Blithewold with our major tree work; we have neither the staff nor the equipment to do that sort of thing. And it's a lot safer too. One may also be able to determine if doing something by machine really is cheaper than doing it by hand. Of course there are also the aesthetic and practical issues to be weighed. One can determine what equipment to buy and when to buy it. It may be better still in some cases to rent, lease, or borrow. And finally, one can more easily determine the type of personnel best suited for the job at hand.

In addition to designing sensitively, talking with maintenance people, and knowing all the pertinent facts, what else can we do? We need to select plants best suited for the site and the situation. Choosing plants for your backyard or balcony is one thing, but what about plants for our city parks, median strips, and planters?

In an article from a special issue of *Arnoldia* on Urban Islands, Gary Koller advised us to select tough plants, ones that are long-lived and adaptable to a wide range of environments, ones capable of thriving under existing site conditions. The combination of stressful conditions and the unfortunate lack of maintenance in environments such as these make careful design and plant selection even more imperative. Planters, medians, and islands that are properly designed can better withstand a city's temperature extremes, pollution, drought, pests, and vandalism.

Maintenance in these situations is not merely necessary to satisfy the plant's horticultural requirements, but is also essential in order to prevent them from attack, and by ATTACK I mean attack from not only dogs, humans, cars, and the like, but financial attack as well. Propositions 13 in California and 2½ in Massachusetts have had serious effects. In Boston the Parks and Recreation budget was cut by 60%, while at the same time capital improvement funds, for even more urban islands and parks, continue to flow.

I've already mentioned the tragic situation in Providence where $7 million was spent to refurbish a park, but not one cent can be found to keep it up. We as users of our parks, sidewalks, and public gardens must become more responsible citizens and urge our civic leaders to include maintenance as part of their overall budget considerations.

And finally, as horticulturists, designers, and just plain lovers of plants, let us please use some restraint! Let us first take care of what we already have before adding more plants and gardens. Let us use the right plants and take care of them properly. Let us keep our gardens, both public and private in good repair, efficient, and usable for a good long time. Let us not be afraid to remove or replace. As Carl Totemeier emphasized at an AABGA* regional meeting several years ago, let us become cost conscious, innovative, and efficient in our maintenance efforts. Funds for maintenance will never be an easy thing to obtain, and the situation will only get worse. As we all know, when budget cuts come, the maintenance department is usually the first to feel it.

Our landscapes can and should be designed for easier maintenance using cheaper equipment, less materials, and fewer personnel. As Charlotte Kahn, Executive Director of Boston Urban Gardeners has said: "Plants in the public realm will be what we make them: symbols of our good stewardship, or proof of our indifference."

**American Association of Botanical Gardens and Arboreta.*

Putting It All Together

What makes a great garden?

BY ALLEN P. PATERSON

There is no lack of texts by garden writers and garden designers which try to answer this. One, *Great Gardens of the Western World* by Peter Coats, does so by inference: the title makes the point. Now read on, it commands, these are they. Certainly, Mr. Coats did well with the writer of his introduction. Harold Nicolson, with his wife Vita Sackville-West was, of course, the maker of one of the acknowledged great gardens of this century. Sissinghurst is a name that has come into the vocabulary of gardens, as Stourhead did in the 18th Century and as Versailles in the 17th Century. Listen to Harold Nicolson: "The essence of garden design, as of all forms of architectural planning, is the alternation of the element of expectation with the element of surprise. There should be present to the mind of the visitor the awareness of the designer's intention; that intention at the same time must be varied, and indeed interrupted, by the unexpected." There should be (and I paraphrase) a main axis of rectilinear perspectives and opening from this main axis there should be smaller enclosed gardens (as Sissinghurst, following Hidcote's example, has).

Nicolson quotes Henry duPont, creator of Winterthur, who recommends that amongst other things "The true gardener should plant boldly in large clumps, he should make all possible use of indigenous trees and arrange colour schemes with meticulous care." Further, the designer must be conscious of his objectives, avoiding fussiness or confusion and by having

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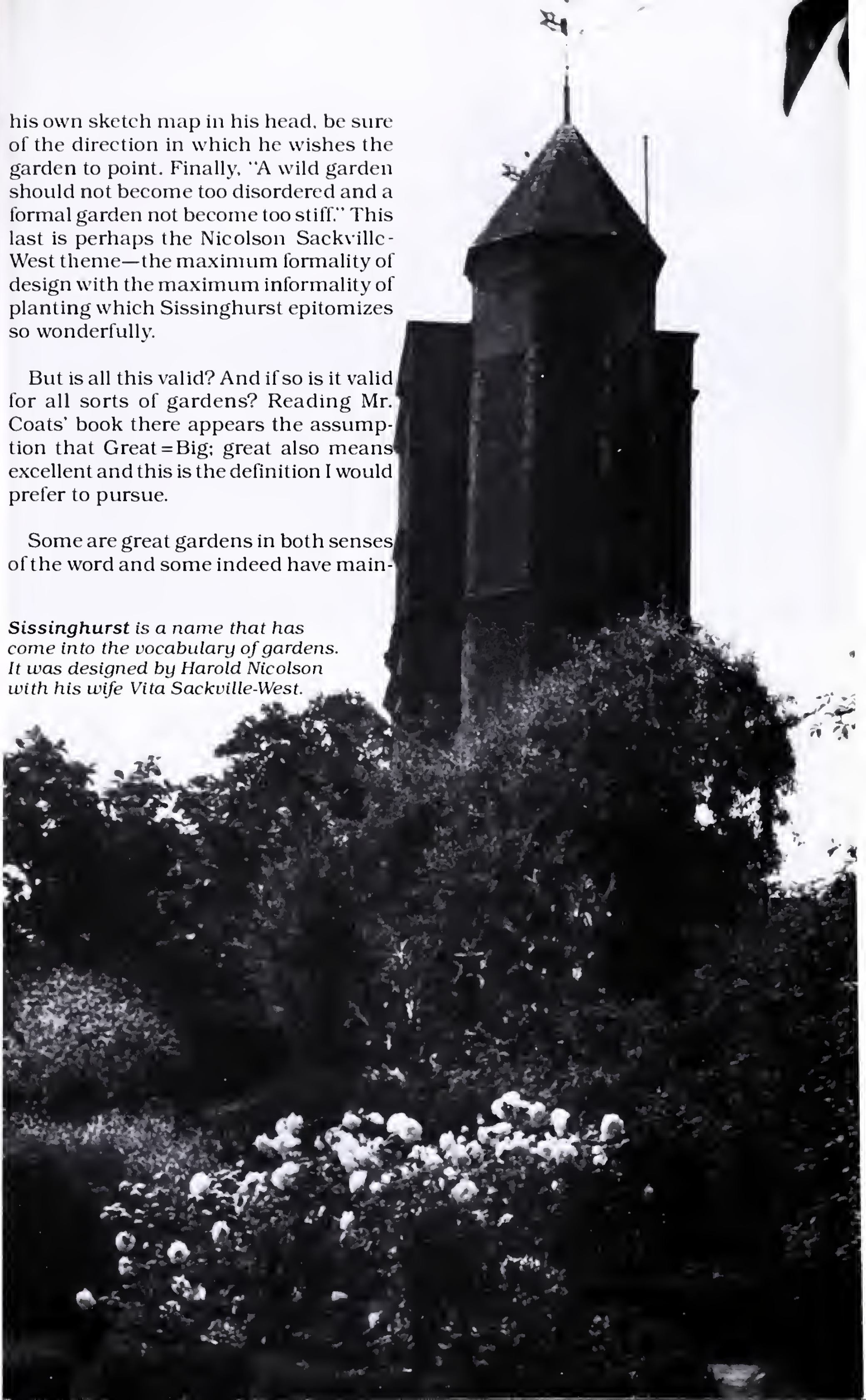
Allen P. Paterson, Director of the Royal Botanical Gardens, Hamilton, Ontario, Canada, is former curator of the Chelsea Physic Garden. Mr. Paterson is a lecturer and the author of several books.

his own sketch map in his head, be sure of the direction in which he wishes the garden to point. Finally, "A wild garden should not become too disordered and a formal garden not become too stiff." This last is perhaps the Nicolson Sackville-West theme—the maximum formality of design with the maximum informality of planting which Sissinghurst epitomizes so wonderfully.

But is all this valid? And if so is it valid for all sorts of gardens? Reading Mr. Coats' book there appears the assumption that Great=Big; great also means excellent and this is the definition I would prefer to pursue.

Some are great gardens in both senses of the word and some indeed have main-



Sissinghurst *is a name that has come into the vocabulary of gardens. It was designed by Harold Nicolson with his wife Vita Sackville-West.*

Vanbrugh's vast bridge *at Blenheim Palace. This artificial landscape was created by Lancelot 'Capability' Brown in the 1760's. Today all artificiality seems dispersed, only perfection remains.*

tained their reputation for a couple of centuries or more: Others are of our own time. Thus we see Vanbrugh's vast bridge at Blenheim Palace, marvellously half drowned by Lancelot 'Capability' Brown in the 1760's, in doing so creating the finest artificial landscape in Europe. Today all artificiality seems dispersed, only perfection remains. Stourhead's evocation of a painting by Claude, Kew's combination of a temple seen through a magnolia in full flower, the Chinese bridge at Pusey House, the sequential 'rooms' of Sissinghurst and Tintinhull—all are, or have been called, great gardens. The list can be extended.

These initial, essentially architectural, images—and the camera does help by putting each one in a carefully contrived frame, a frame chosen by the onlooker who, *in* his own time, by doing so, interprets the image of the past (distant or recent *for* his own time)—help to illustrate Harold Nicolson's dicta. In many ways they become truisms: the parts hold together to illuminate the whole. The design has a conviction of its own effectiveness, the scale is suitable for its site. These gardens tell the observers what the garden was for, reflecting its time and taste of its maker.

Often, it seems, there is a dependence upon non-natural artifacts: statuary,

steps, balustrades. But to indicate that such materials are not necessary to great gardens I can show gardens, big and small, whose artifacts detract from, rather than help, the gardens they adorn. Barrow Court in Somerset is one such. An Inigo Thomas garden of the early 20th Century it has fine gazebos, ornaments, an exhedra of tall terms illustrating the months at the end of a vast lawn all marvelously sculpted. But these are dream images, nothing really relates to the house. It is as if the owner, leafing through a folio of plans said "I'll have one of those and, while you are about it add that, and that, and put it all over there."

But worse, not all artifacts are by any means worthwhile in themselves. Look now at a Quebec Snow White and her dwarfs all in multicoloured plastic, a bronze Savannah child feeding a bird, dangerously coy, a Victorian Venus in white marble, clearly unhappy with her lot in Richmond, Virginia. The intended evocation of the classical world which she is meant to convey fails: like some wine, garden ideas ethnically often fail to travel well. Where they do the pictures need to be classically complete as at Stourhead or, turning to the Orient as here at Brooklyn, virtually enclosed. Perhaps then, instead of merely adding sculptural elements, (and I doubt if this is an original idea) each garden needs to be conceived as a piece of sculpture in its own right. A walk-through sculpture which, unlike that which is merely observed once it is made, is continually worked upon by that fourth dimension, time.

In our Western culture the term 'garden' is indivisible from the term 'plant'—used as a verb and, in all the multiplicity which is possible, as a noun. Great gardens to most of us mean great plants, great plantings. Merely to have a vast collection is not enough—that just makes a Botanic Garden not necessarily a great one—the plants must be considered elements in the plan, but elements inevitably changing by the season, by the year and as we have heard in Mrs. Poor's impassioned plea for *Plants that Merit Attention*, by the decade and beyond.

But before we look at plants we might just consider the invitation to that look—a garden's entrance: its preface, its overture, to use analogies from other art forms. Here we have the marvelous Danby gateway to Oxford's Botanic Garden built by Inigo Jones' master mason, in the 1620's or 30's, or the arch which links the lodges to the entrance court, at Cranborne Manor. It helps if the garden's frame is fine architecture in its own right but simple doors into cottage gardens show it not to be essential. Again scale and suitability is vital to the perception and understanding of the garden within.

An inviting entrance produces a sense of movement. Great gardens maintain this. Look, at Hideote, at this processionary enfilade from garden to garden as room to room in a great house in which suddenly, from enclosure, a wide view is presented to the astonished gaze.

But eventually (in fact, at once and enroute) we look at the plants, the fur-

***Barrow Court**, located in Somerset, is an Inigo Thomas garden of the early 20th Century. It has an exhedra of tall terms illustrating the months of the year—dream images not really relating to the house.*

A garden's entrance *is an invitation to look—its preface, its overture. Above, upper, the Danby gateway to Oxford's Botanic Garden, built by Inigo Jones' master mason in the 1620's. Lower, a door at Folkington Place.*

nishings. In doing so we relate to other contribution subjects in this celebratory conference: the untold miles travelled by Dr. Creech and his confreres to collect good plants around the world, the carefully chosen shrubs of Dr. Dirr, the vines and ground covers of Mr. Koller and Mrs. Harper's herbaceous "grace notes." All are in the palette a garden artist works from.

But however good the plants, however eclectic the choice, it is the manner of their use that spells greatness in this context. "Plant associations" has become something of a cliche, nonetheless the making of effective garden pictures, season by season, is vital. Thus groups demonstrate ecological sense (no rhododendrons in a limestone quarry), intense use of ground by suitable stratification and often avoidance of monocultures (rose beds with nothing else neglect half the year). It is not difficult to find visual examples of all these factors, picking out the amazingly original: a white form of *Lilium auratum* with fruiting *Actaea alba* at Frank Cabot's Malbaie garden in North Quebec, serendipity at its best, shoots of *Paeonia mlokosewitschii* unfolding through a sheet of flowering lesser celandines. Size of garden here is utterly immaterial.

Often, though, effectiveness is spoilt through over-gilding the lily. When to stop, indeed when even to start, as a North Carolina pinewood alive with unfurling fern-fronds shows, is perhaps just as important. It is easy in this context to apply two of Oscar Wilde's well-known aphorisms. This pinewood dispels the suggestion that "nothing succeeds like excess;" that it is unusual indicates that most people, like Mr. Wilde himself, can "resist anything except temptation".

Throughout, a great garden, be it broad acres or a tiny town courtyard demonstrates two things beyond its basic design. Both are human factors. There must be an intense personal involvement of the owner. He (or today more likely she) may

***It is the manner** of plants' use that spells greatness. Above,* Paeonia mlokosewitschii *with lesser celandines.*

***Right, a white form** of* Lilium auratum *with fruiting* Actaea alba.

be the sole labourer in his particular vineyard. There may be professional help (an ever less common situation) but no garden is kept great without a presiding deity. One of the remarkable facts of Sissinghurst is that after a dozen years or more in the care of the National Trust, it is still those very special Nicolsons' very special garden—but then it is still in the personal care of the joint headgardeners (both women) whom Vita Sackville-West appointed before her death.

Involvement means several things: the continual on-going planning, replanning, planting and replanting and the use throughout of a critical eye. It also means ensuring effective maintenance: to misquote the old hymn: "Time, like an ever-rolling stream bears all its plants away." Great gardens work *with* time not against it. Brooklyn Botanic Garden by this conference is celebrating its 75th Anniversary: it is immeasurably a greater garden than it was after, say, its first or second decade. Perhaps the simplest admonition to anyone here today searching for a great garden is to leave the room at once and walk about BBG. The question posed by this talk then becomes answered osmotically.

RECENT BOOKS WORTH NOTING

In the Library of the Brooklyn Botanic Garden
(Please order directly from your bookstore, not from the Botanic Garden)

BEAUTIFUL BOOKS

Color in Your Garden by Penelope Hobhouse. Little, Brown & Company, Boston. $35.00
Large format book is a delight to the eyes because of its color illustrations. Book begins with chapter explaining how color works in the garden. The remainder is broken down by color. Should serve as an inspiration but do remember transatlantic translations.

Flowers Rediscovered by Mädderlake. Stewart, Tabori & Chang Publishers, Inc., New York. $35.00
The subtitle, New Ideas About Using and Enjoying Flowers, *says it. The book itself is an inspiration. Two hundred beautiful photographs provide infinite pleasure and many new ways of using flowers. Exquisite!*

Leaves by Kjell B. Sandved and Ghillean T. Prance. Crown Publishers, New York. $35.00
Breathtaking photographs by Sandved make this book a delight to peruse. However, the text is definitive on the subject of leaves while remaining highly readable.

Visions of Paradise by Marina Schinz & Susan Littlefield. Stewart, Tabori & Chang, Publishers, Inc., New York. $39.95
Photographer, Marina Schinz, has collected superb photographs of gardens all over the world. Each page is a treasure. Beautifully produced—a most glorious book!

BRITISH GARDENS AND GARDENERS

There have been an extraordinary number of books on gardening from England. Most have been written by experts in their fields. However, if not conscientiously adapted to American gardens and climates, the use of the plants described is risky.

The Dictionary of Roses in Colour by S. Millar Gault and Patrick M. Synge. Merrimack Publishers' Circle, Salem, New Hampshire. $14.95
Here is another book from England produced in conjunction with the Royal Horticultural Society and the Royal National Rose Society. Nice color section of photographs—over 500 in number.

The Encyclopedia of Gardening Techniques edited by Christopher Brickell. Exeter Books, New York. $14.95
Based upon the Royal Horticultural Society's experience at Wisley which is a center for research into plants and techniques. Lots of good basic information, but remember this is another book from England and transatlantic differences must be considered.

English Cottages and Farmhouses by Olive Cook. Thames and Hudson, New York. $10.95
Lovely black & white and a few color photographs provide the flow of rare and vintage structural treasures.

The English Garden Room by Alan Toogood. Merrimack Publishers' Circle, Salem, New Hampshire. $16.95
A pictorial survey of private conservatories illustrated in color. How to build, plant interiors and plants to use.

The Gardening Encyclopedia by John Gilbert. Merrimack Publishers' Circle, Salem, New Hampshire. $14.95
Covers most aspects of gardening in a clear concise manner. Color illustrations are attractive. But, again, the information is for British gardens . . . must be reapplied to American gardens.

Little English Backyards by Roddy Llewellyn. Merrimack Publishers' Circle, Salem, New Hampshire. $12.95
Described as an idea book, this slim volume provides suggestions mainly through color photographs of different gardens. Attractive.

Making A Cottage Garden by Faith and Geoff Whiten. Merrimack Publishers' Circle, Salem, New Hampshire. $15.95
If you want to create an English cottage garden, here is help. The authors researched subject to create their prize-winning garden at the Chelsea Flower Show.

The Practical Guide to Successful Gardening by Alec Bristow. Merrimack Publishers' Circle, Salem, New Hampshire. $17.95
The contents cover garden design and then month by month in the garden. Thorough treatment and lovely to peruse. It is written for England, however.

The Queen's Hidden Garden: Buckingham Palace's Treasury by David Bellamy; botanical paintings by Marjorie Lyon. Merrimack Publishers' Circle, Salem, New Hampshire. $19.95
The subtitle says it—Buckingham Palace's treasury of wild plants. This is a handsome, large-format book with charming paintings in color. Each plant found in the gardens is described in this fact-packed text.

Rock Gardens and Alpine Plants by David Joyce. Arco Publishers, Inc., New York. $11.95
How-to book on constructing and planting a rock garden. Illustrations in color. This is a book from England with an American editor. Still treat with caution as far as plant materials go!

Salem House Book of the Water Garden by Philip Swindells. Merrimack Publishers' Circle, Salem, New Hampshire. $12.95
Covers building, maintenance, planting, problems of water gardening. Black & white drawings and color plates illustrate each phase in a clear manner.

Tresco: England's Island of Flowers by Ronald King. Merrimack Publishers' Circle, Salem, New Hampshire. $19.95
Author traces the fascinating history of the development of the gardens of Tresco Abbey. Many of the illustrations are from the Abbey collection.

The Victorian Garden by Tom Carter. Merrimack Publishers' Circle, Salem, New Hampshire. $19.95
Illustrated mainly with drawings and photographs of the period. Extracts from writings of the time as well.

The Wild Garden by Violet Stevenson. Penguin Handbooks, New York. $12.95
Lovely book with color photographs and helpful plant guides, but again a book from England that needs to be translated for American needs. Pleasure to read and to look at.

GARDEN DESIGN

The Backyard Planner by Donald Meyers. Charles Scribner's Sons, New York. $17.50
A great deal of useful information for the homeowner. How-to instructions on walks, walls, fences, lighting, planting, etc. Not too attractive but lots of good tips.

Beatrix Farrand's American Landscapes—Her Gardens & Campuses by Diana Balmori, Diane Kostial McGuire & Eleanor M. McPeck. Sagapress, Inc., Sagaponack, New York.
The authors of this book were brought together to help with a major exhibition of Farrand's work at Wave Hill. This book is the result.

The Complete Urban Gardener by Joan Puma. Harper & Row, New York. $14.95
In-depth look at gardening on a rooftop or terrace. Drawings, black & white photographs and some color complement the charts. Handy reference for this specialized form of gardening.

Earthly Delights by Rosalind Creasy. Sierra Club Books, San Francisco. $19.95
Text devoted to twelve theme gardens such as meadow, cottage, child's. Lots of references, photographs and drawings. Book is a delight to read and peruse even if you don't intend to make a particular garden.

Garden Planning and Design by P. Francis Hunt. Arco Publishing, Inc., New York. $11.95
Points made largely through the use of color photographs and drawings. Another book from England, however, so treat plant suggestions with caution.

Home Landscaping in the Northeast & Midwest by Ken Smith. H.P. Books, Tucson, Arizona. $9.95
Color photographs and sketches give lots of ideas for the landscaper who is redesigning his garden or starting from scratch. Not an in-depth treatment.

Maintaining the Spirit of the Place by Harry Launce Garnham. PDA Publishers Corporation, Mesa, Arizona. $15.95

Process designed to prevent undesirable changes in towns. Techniques described for preservation, revitalization and maintenance of special character. Model of Navasota, Texas, used.

Site, Space and Structure by Kim W. Todd. Van Nostrand Reinhold Company, Inc., New York. $25.00

Land use integrated with people's needs to produce required building. Seems more for professional or highly interested amateur building planner.

GARDENING TECHNIQUES

A Guide to Home and Garden Pests by Charles Kingsley Levy. Viking Penguin, Inc., New York. $7.95.

How to identify and eliminate them safely. Book deals with prevention as well. Written with humor so it is enjoyable to read in spite of the unattractive subject matter.

The ABCs of Gardening: Outdoor & Indoor by Marjorie J. Dietz. Doubleday & Company, Inc., New York. $12.95

Bits of information on a wide range of gardening topics—no in-depth treatment. Arranged alphabetically for easy reference.

Better Vegetable Gardens the Chinese Way by Peter Chan. Garden Way Publishing, Pownal, Vermont. $9.95

Step-by-step instructions on how to garden in raised beds. Lots of tips for successful gardening. Illustrated.

The Fine Art of Salad Gardening by E. Annie Proulx. Rodale Press, Emmaus, Pennsylvania. $9.95

All the makings of salads discussed, with cultural information, unusual varieties and recipes. Illustrated with line drawings. Source list.

The Salad Garden by Elisabeth Arter. Croom Helm Ltd., Dover, New Hampshire. $15.00

Here is information on growing the makings of salads, recipes and what to buy. However, the book is from England—source lists as well.

Tips for the Lazy Gardener by Linda Tilgner. Garden Way Publishing, Pownal, Vermont. $4.95

A collection of tips from gardeners for more efficient gardening. Entertaining reading.

The Vegetable Gardener's Journal by Oliver E. Allen; illustrated by Mary Rankin. Workman Publishing, New York. $14.95

Lovely illustrations, monthly tips for gardening tasks and space to make notes. Nice gift.

Wildlife Pest Control Around Gardens and Homes by Terrell P. Salmon and Robert E. Lickliter. Cooperative Extension, University of California, Oakland. $8.00

Here is an excellent guide to controlling wildlife damage. The key is often identifying the culprit. Color and black & white photographs illustrate what to look for and the methods of control.

HERBS AND DRIED FLOWERS

The Art of Preserved Flower Arrangement by Maureen Foster and Bryan Foster. Merrimack Publishers' Circle, Salem, New Hampshire. $18.95

Nicely illustrated guide to the use of dried flowers. Reference section supplies the information on different ways of drying materials.

Chinese Tonic Herbs by Ron Teeguarden. Harper & Row, Publishers, Inc., New York. $13.95

Interesting reading. Discusses the principles of Oriental health philosophy. Also recipes and sources.

Everlastings: The Complete Book of Dried Flowers by Patricia Thorpe. Facts on File, Inc., New York. $17.95

Growing, collecting, drying methods. What to dry and how to use them. Nicely illustrated.

PLANT GROUPS

The Checklist of Species, Hybrids and Cultivars of the Genus Fuchsia by Leo B. Boullemier. Sterling Publishing Co., Inc., New York. $17.95
The title says it. Be cautious since this book is for England.

Combined Rose List by Beverly Dobson, 215 Harriman Road, Irvington, N.Y. 10533. $7.50 ppd.
Prepared each year, this is the most complete listing of old and modern roses and where to find specific varieties commercially available.

The Cultivated Hemlocks by John C. Swartley; revised by Humphrey Welch. Timber Press, Portland, Oregon. $24.95
Original thesis upon which this book is based has been revised and updated. Excellent reference for growers and collectors of dwarf hemlocks. Unfortunately the photographs do not do the genus justice.

Ferns to Know and Grow by F. Gordon Foster. Timber Press, Portland, Oregon. $29.95
This is an enlarged revised edition. Some 132 species of hardy and tender ferns are described. Line drawings of leaves, stems, spores and crosiers for each species are helpful.

Growing and Propagating Wild Flowers by Harry R. Phillips. The University of North Carolina Press, Chapel Hill, North Carolina. $14.95
General information precedes the main part of the book which is an encyclopedia. Includes carnivorous plants and ferns. Black & white drawings and some color plates.

Growing Lilies by Derek Fox. Croom Helm, Ltd., Dover, New Hampshire. $29.95
Contains a lot of practical information on growing lilies. Illustrated with color plates and nice black & white drawings. Good reference.

The Handbook of Soft Fruit Growing by David Turner and Ken Muir. Croom Helm Ltd., Dover, New Hampshire. $22.50
Contains lots of good information. This is another book from England so treat information with caution.

Holland Bulb Forcer's Guide by Dr. August DeHertogh in cooperation with the Holland Bulb Exporters, International Flower-Bulb Center and North American Flower-Bulb Wholesalers. International Flower-Bulb Centre, Hillegom, The Netherlands.
Primarily of interest to the florist industry although there is information presented on outdoor bulbs. Excellent resource for a wealth of information.

How to Grow Bulbs, Sunset Books, Menlo Park, California. $6.95
Covers a wide array of bulbs in a thorough manner. The addition of color is welcome. Facts checked by a member of our staff. Sunset *has an excellent reputation which is carried out in this book.*

How to Grow Fruits, Nuts and Berries by editors of Sunset Books & Magazine, Lane Publishing Co., Menlo Park, California. $5.95
The usual thorough treatment of the subject by Sunset *editors. The addition of color makes reading more pleasurable. Climate zone maps cover all of U.S. with suggestions for best bets in your area.*

Peppers, The Domesticated Capsicums by Jean Andrews. University of Texas Press, Austin. $35.00
Beautiful life-size drawings by the author begin this large book. History, taxonomy and biology of the plants described. Recipes follow. Handsome book.

Orchid Growing Illustrated by Brian and Wilma Rittershausen. Sterling Publishing Co., Inc., New York. $19.95
A great deal of information is conveyed through photographs—color and black & white. Covers most aspects of orchid growing for the amateur.

The Smaller Rhododendrons by Peter A. Cox. Timber Press, Portland, Oregon. $29.95
Good reference written by a grower who lives in Scotland. Contents include natural distribution and introduction as well as garden culture. References.

Trees of Central Texas by Robert A. Vines. University of Texas Press, Austin. $10.95
A field guide to the native and naturalized trees of central Texas. Illustrated with black & white line drawings.

Tropical Asiatic Slipper Orchids by Kenneth S. Bennett. Merrimack Publishers' Circle, Salem, New Hampshire. $15.95
Written for the layman, this book contains information on general cultivation, propagation, pests and diseases. Individual descriptions plus color plates make this a useful volume.

POISONOUS PLANTS AND MUSHROOMS

A Field Guide to Poisonous Plants and Mushrooms by Charles Kingsley Levy and Richard B. Primack. Penguin Books, New York. $9.95
Typical field guide format with clear black & white drawings and some color plates cover North American poisonous plants. Symptoms of ingestion, treatment and prevention discussed.

AMA Handbook of Poisonous and Injurious Plants by Kenneth F. Lampe and Mary Ann McCann. Chicago Review Press. $18.95
Excellent reference which is well organized. Field guide-like last section is a collection of color photographs, which are arranged alphabetically. Unfortunately, would have been more helpful if keyed by flower and/or fruit color.

Harper's Mushroom Reference Guide and Check List by Herbert H. Harper. 8975 North Shore Trail, Forest Lake, Minnesota 55025. ($1.50 postage) $12.95
1775 species of fungi of U.S. and Canada. Includes common and scientific names, habitat and edibility. Useful reference.

Poisonous Plants: A Color Guide by Lucia Woodward. Hippocrene Books, Inc., New York. $12.95
Nice color photographs with helpful keys, covers fungi, wild and cultivated plants. Learn what to avoid and what to use.

A MISCELLANY

A Camera in the Garden by Heather Angel. Merrimack Publishers' Circle, Salem, New Hampshire. $19.95
A practical guide to photographing gardens. Beautiful illustrations add to this book. Look at your garden in new ways in order to use your camera more imaginatively.

A Field Guide to the Familiar: Learning to Observe the Natural World by Gale Lawrence. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. $9.95
Organized by the seasons, this guide gives tips on new ways to look at familiar things around you. Good introduction.

Beauty and the Beast: The Coevolution of Plants and Animals by Susan Grant. Charles Scribner's Sons, New York. $14.95
Many examples of plant and animal coevolution are described in a delightful manner. Fanciful drawings add whimsey to this slim volume.

Bogs of the Northeast by Charles W. Johnson. University Press of New England, Hanover, New Hampshire. $12.95
Written by a naturalist this book is a natural history of the bogs of the northeast. Interesting.

Concise Science Dictionary by Market House Books. Oxford University Press, New York. $22.50
Good reference for students. Covers all scientific disciplines in the 7000 plus entries.

Eastern Forests: The Audubon Society Nature Guides by Ann Sutton and Myron Sutton. Alfred A. Knopf, New York. $14.95
One of a series of guides, illustrated with color photographs, to the trees, wildflowers, mammals, birds and insects—this one of Eastern forests and woodlands. Handy reference although format is a bit large for the pocket.

The Intertidal Wilderness by Ann Wertheim. Sierra Club Books, San Francisco. $14.95
A beautiful collection of photographs of plants and animals of the intertidal habitat of the west coast. Some text but mainly exquisite photographs.

The Reluctant Naturalist by Charles Monagan. Atheneum, New York. $10.95
Take a look at the familar world through the eyes and imagination of this creative author. It's wonderful.

The Sex Life of Flowers by Bastiaan Meeuse and Sean Morris. Facts on File Publications, New York. $19.95
Mainly devoted to the variety of methods evolved by plants to achieve pollination. Beautifully illustrated, mainly in color. The book is based on the PBS presentation: "Sexual Encounters of the Floral Kind."

The Staffs of Life by E.J. Kahn, Jr. Little, Brown and Company, Boston. $19.95
Author focuses on five major crops: corn, potatoes, wheat, rice and soybeans. Researched extensively, the book is fascinating reading.

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I certify that the statements made by me above are correct and complete.

Barbara B. Pesch *Editor*

In Memoriam

Clarence E. Lewis, long-time friend of BBG and guest editor of several PLANTS & GARDENS handbooks, died September 10, 1985.

Known to friends and students alike as Clancy, his warm, outgoing personality and gifted insights endeared him to everyone who knew him.

Clancy had retired from Michigan State University in 1972 after serving as Professor of Horticulture for fifteen years. His special interests were trees and shrubs, which he photographed with a keen eye. Retirement did not slow his pace, for he continued to travel and lecture.

He was an author, having written articles and having contributed to many books. His photographs have appeared in numerous publications.

Clancy's legacy to his students and friends was a fresh way of observing the landscape. For him, a tree in winter represented a work of art. He lives on for many of us who were fortunate enough to know him.

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